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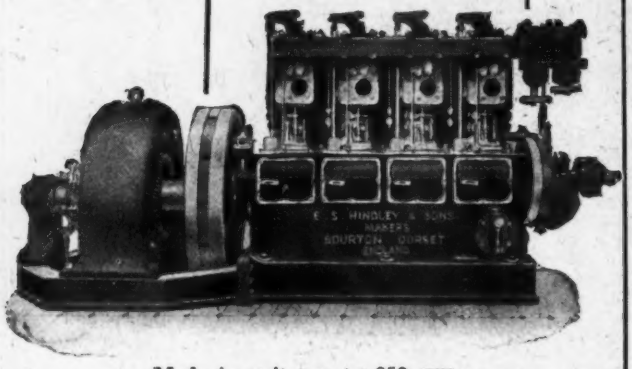

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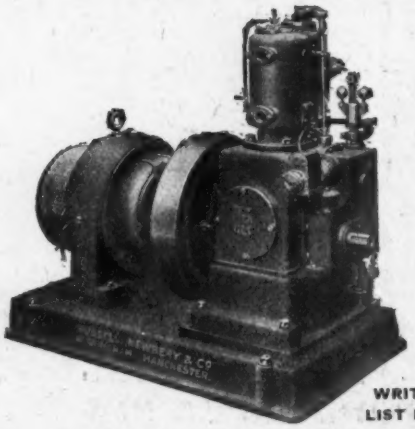

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THE

ELECTRICAL REVIEW.

VOL. XC. APRIL 28, 1922. No. 2,318.

ELECTRICAL REVIEW.

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CO-OPERATIVE TRADE EXPANSION.

THE very interesting subject of co-operation among British manufacturers in the securing and execution of large electrical and other engineering contracts abroad has again been brought prominently before the attention of everybody by the public announcements that have been made of the registration of a new company formed by a number of industrial concerns of world-wide connections and unquestionable and substantial reputation.

When the great names of Arrol, John Brown, Cammell Laird, and the North British Locomotive Company, in the iron and steel and engineering world, are linked up with that of the English Electric Company, itself already an amalgamation of a number of well-known interests, and with that of the Prudential Assurance Company representing vast financial experience and resources, we may take it for granted that large matters are in contemplation. We may also reasonably hope that such united action as the new group will take will assist the nation in securing big business in competition with the outside world, which shall contribute substantially to the volume of work available for British works and for British workers.

It must be nearly twenty years ago since we first advocated in these pages the policy of co-operative action among British engineering manufacturers in overseas markets. Many experiments have since been tried, and a great deal of experience has been gained. Groups of firms each specialising in a different class of product have joined hands in order to act with strength and resource when large propositions were forward, in Egypt, in China, in Canada, in pre-war Russia and Siberia. Some of them failed and little was heard outside their own circles of the causes of failure; others succeeded up to a point, but world-conditions proved to be too strong for them, the times not being favourable for those interested to reap the harvest which justifiably appeared to be ripe for the foreign-traders' sickle. Experience was gained by many men who are still amongst us, which leaves them as convinced as ever of the value of group action as a means of securing substantial trade when world-confidence returns, freeing for execution those vast engineering schemes which must inevitably be carried out when civilisation can afford to avail itself of the services of science, industry, and organising ingenuity in the development of the earth's resources. Is that time approaching? There are some favourable signs and symptoms, and doubtless the new company (the Power & Traction Finance Co., Ltd.) has been formed now in order to be in a position to be ready as opportunities arise to use the immense works, experience, and facilities that its constituent companies possess, in taking advantage of them for the

supply of any or all of its varied products in so far as they may be needed in the carrying out of very large works such as the laying down of a new railway, the electrification of a railway from start to finish, a complete hydro-electric undertaking, big harbour works, shipbuilding operations, and so forth.

Not only is practically every industrial side (even including coal and iron production) represented in the whole, but each constituent company is represented in practically every part of the world. Tendering should become a simpler matter, and the submission of one comprehensive scheme for a large complete undertaking would give ground for larger hopes of successful competition against similar offers submitted from other countries.

The importance of the financial element in the scheme can hardly be exaggerated, for it will serve to strengthen all the other parts of the organisation without drawing directly upon the individual financial resources which any one of them may be needing for its direct productive operations. Long financial credit may be given by the group which it might not be policy for its constituent parts to undertake on their own account, and settlements in the form of securities not easily realisable and therefore often unacceptable to a firm requiring its funds to be in fluid form, might be accepted by united forces. It would seem that strong and united effort on the industrial and commercial sides will be backed by financial readiness to tackle any sound proposition.

One of the differences between the new company and those that have been formed in the past is the largeness of the manufacturing interests directly concerned in it. Another is the time of its formation—a moment when British prestige stands higher than ever, when the world is trying hard to break the shackles put upon development by the events of 1914 and following years, and when international competition is not materially weakened, though it is undergoing marked changes.

It has been urged by expert advisers in many lands that by the group system alone, in which the constituent parts are linked together by mutual interests, could British manufacturers hope to succeed in competition with the vast organisations operating from other industrial countries. The new concern is one more effort in that connection, and its experience will be watched with keen interest.

But there have been trials made of other kinds of co-operative schemes, as our readers are well aware. Electrical companies making various kinds of machinery, apparatus, and accessories have joined hands in complete amalgamation as one concern, the greater absorbing the less without forming a separate company for the purpose, and they have been strong enough both in point of finance and in respect of business-getting organisation to give a good account of themselves. We have several notable examples leading the electrical industry. Some of these can undertake the execution of complete electrical installations of the largest kinds—a point with regard to which formerly we were weak in meeting Teutonic competition even in British colonies. Further, there are large companies, and some with specialised lines of manufacture, which are so placed that they feel that they can go alone. Their continued success is a proof that there is room for all kinds of activity and for all degrees of organisation and super-organisation in the electrical and allied industries. In some cases makers of motors, switchgear, and so forth, have acted in concert through joint subsidiary companies operating as selling organisations overseas. Sometimes these arrangements succeed, sometimes they do not.

There is another kind of co-operation which is a matter of principle or policy rather than a detailed piece of business and financial organisation. This class of co-operation has unquestionably been a good thing for the industry when its operations have been limited to a legitimate field; but experience has justified the criticism that it has its limitations, for limitations to joint action must exist where private enterprise is seeking profit for different parties. When the legitimate line is passed, co-operative effort may lead to waste effort and to waste of money, saddling an industry with burdens which there is no need whatever for it to carry. Unnecessary things or attempted duplication of the expert and experienced efforts of others do not add to the economy or efficiency of associated industrial organisation, and they contain within them the seeds of failure.

A large and representative association may do a world of good if it limits its activities to matters that are really essential, but it may mar its usefulness to an industry and to its members if its solicitude is shown where it is not sought, merely for the purpose of justifying its existence or proving that, because it is invaluable in some respects, it is entitled to be a sort of "universal provider" in all. How often it has happened that there has been more waste of time, thought, and money upon the things that do not matter than upon those that are of first importance but just a little dangerous to touch!

The E.T.B.I.

The holding of the annual general meeting of the Electrical Trades Benevolent Institution affords a suitable occasion for us once more to impress upon our readers the obligation which rests upon the electrical industry to support this, its very own benevolent institution, in every possible way. We venture to suggest that this is emphatically not a matter for the other fellow to look after; it is a *personal* responsibility which to a greater or less extent affects every one of us by virtue of our share in the industry. The fact that our liability is a voluntary burden in no way lessens its incidence—rather it makes the matter a debt of honour; but there is no need to put it on so high a plane, for it is in fact a simple and inexpensive method of insurance. For the small payment of 10s. a year a member is entitled to the full benefits afforded by the Institution in the event of his being in need of assistance—and how many of us can be sure that we shall never qualify for relief? Those who are in that happy position are all the more bound to contribute towards the needs of their less fortunate brothers, and those who are not so happily circumstanced would be well advised to enrol themselves as members without delay. Lastly, we would draw attention to the invaluable work of the local advisory committees which have already been formed, and to the vast scope that is open for the formation of such committees, as well as for the institution of collectorships; any collector who collects the subscriptions of five members or raises the sum of £5 a year becomes entitled to the privileges of membership, and this provision enables those who cannot afford a personal contribution to render valuable assistance to the Institution whilst also doing themselves a good turn.

Chelmsford One-man Strike.

The refusal of a jointer in the Chelmsford undertaking to connect up an installation, on the ground that the wiring was done by non-union labour, has expanded into a general case. The Chelmsford undertaking brought the matter before the District Council (No. 9), and asked for a settlement of the principle. The employers' side of the District Council agreed that some settlement of the whole question ought to be come to, which should safeguard undertakings from being subjected to these spasmodic one-man strikes. The employers' side indeed went so far as to pass a resolution to the effect that unless such individual strike action could be prevented, they were not prepared to go on with the Council. On

the matter being referred to the National Council, the employers' side supported the attitude of the No. 9 District employers, and the trade-union side is left to find some way out of the *impasse*. That is how the matter stands at the moment. This question of the employés of electricity undertakings using their position to boycott contracting firms which do not fall in with trade-union requirements is, of course, one which has been of serious concern to undertakings for some time past, and naturally such a matter must sooner or later come to a climax. It is obviously unreasonable, to say the least of it, for the trade unions to expect that the employers' side will faithfully adhere to all schedules of wages and working conditions and generally carry out the recommendations of the Industrial Councils, and at the same time not be assured of immunity from strikes. The trade unions must realise that if the Councils cannot ensure the very thing for which they were created, namely, the peaceful carrying on of the work of an undertaking as between employer and employed, then it is only a question of time before some undertaking asks: "What is the use of these Councils?" It is a thousand pities that this trouble has arisen, just when the Industrial Councils are taking their permanent place in the organisation of the industry. Still, we trust that the good sense of the trade unions interested will come to the rescue, and that this dispute, which after all is concerned with a very small issue, will be quickly cleared up.

An Aftermath of the War.

The case of "Sutton *v.* The King," which was reported in *The Times* of April 12th, involved the discussion of a question of considerable importance to men who volunteered for service during the war on the terms that they should continue to receive their civil pay. The suppliant was a skilled telegraphist in the employ of the Post Office. In 1915, responding to a call for volunteers, he joined the Royal Engineers on the terms that he should receive full civil pay! At the time when he joined he was earning 68s. per week. While he was with the Colours, the remuneration of men of his grade was increased by bonuses from time to time, so that when he came back to civil life in 1919 his wage was 104s. 7d. The Postmaster-General having refused to pay him more than 68s. per week for the time that he was in the Army, he sought, by petition of right, to claim all the bonus additions, which amounted to £81. Mr. Justice Darling decided for the suppliant, but in the Court of Appeal this decision was reversed by a majority of two to one. Lord Justice Bankes said that to hold that the suppliant was entitled to the bonus additions would be to do something which the parties could not have contemplated. He said: "Under the special conditions arising in consequence of the war there must necessarily be circumstances where special allowances for special conditions are given, and it could never have been contemplated that persons not subject to the special circumstances and conditions should receive the special allowances."

It is easy, of course, to be wise after the event, and to say that when the call for men was made those in authority should have stated that the allowance was to be 68s. per week and no more whatever happened; but this was overlooked. In 1915 the desire was to get men, and no one appears to have been over careful as to the means adopted. The Solicitor-General drew attention to the importance of the case, saying that although the sum in dispute was comparatively small, there were other claims of a similar nature pending which might involve the taxpayer in liability for hundreds of thousands of pounds. Nor does it stop there. Numerous private employers encouraged their men to enlist by offering to pay full salaries. Whether such agreements are contracts enforceable by action may be debatable; but the employer will not be easy in his mind until the question in "Sutton *v.* The King" has been finally decided by the House of Lords. Incidentally, the case draws attention to something which is at the root of many of the financial difficulties which now embarrass the statesman and the country. To meet great and pressing needs the taxpayer was committed to enormous burdens of which he is only now feeling the real weight. Perhaps it was thought that Germany, when vanquished, would pay; but that is a dream which has not been realised.

As regards the merits of the particular case, we cannot think that a telegraphist who joined up and received more than three pounds a week in addition to his Army pay can have very much to complain of. As compared with the man who volunteered with no employer at his back, or any member of the old Army which was wiped out during the first few months of the war, his position is fortunate in the extreme.

Safety First on the Railways.

Although the Report of the Railway Electrification Advisory Committee, published by the Ministry of Transport last year, has no mandatory effect, its purpose was certainly to indicate the lines upon which, in the opinion of the Committee, future developments should take place. Apart from the suggested standards for clearances, &c., the principal recommendation was that direct current should be adopted at a pressure of 1,500 volts or a multiple thereof. The question whether the contact rail or the overhead conductor should be employed was left open, though, as we remarked when commenting on the interim report in October, 1920, the latter is much to be preferred when a high pressure is employed.

In our issue of March 31st, 1922, Mr. Theodore Stevens, who has an intimate knowledge of the details of railway electrification both at home and abroad, drew attention to the view of Mr. George Gibbs that a third-rail system at 1,500 volts could not be installed on American railways with safety to the public and the employés, an opinion which, in its bearing upon British conditions, he emphatically endorsed. Mr. Stevens on Monday last completed a course of lectures which he has been delivering to fifth-year students of the L.C.C. School of Engineering and Navigation, and devoted attention especially to the question of safety. After quoting other objections raised by Mr. Gibbs to the use of the third rail on technical grounds, such as discontinuity at complicated crossings, obstruction, &c., he stated that Mr. Gibbs was of opinion that 1,200 volts, or even 1,500 volts, was not high enough for economical results, and should not be used on the third rail. French experts had also decided that above 1,500 volts the overhead conductor was essential.

In view of the steady progress that is being made in the development of high-pressure d.c. machines, mercury-vapour rectifiers, and other means of converting a.c. to d.c., it cannot be doubted that pressures exceeding 3,000 volts d.c. (which has been used for many years on the Chicago-St. Paul railway) will come into use for economical reasons, and it is most important that all new main-line construction shall be carried out with due regard to this consideration. Mr. Stevens condemned the adoption of 1,500 volts on the third rail, and questioned whether the Advisory Committee had ever considered the risk to life at all; even trespassers, he remarked, did not deserve sudden death as a punishment for trespassing! For suburban services he strongly advocated the 600-volt third-rail system, and gave estimates showing that any saving in cost due to the use of a 3,000-volt (1,500-1,500-volt three-wire) third-rail system would be more than counterbalanced by the increased cost of the track construction and rolling-stock equipment.

In addition to safety, the advantage of uniformity attaches to the 600-volt system for suburban service; but for the major schemes of electrification which we hope to see put in hand before long, we believe the weight of evidence and experience is wholly on the side of the overhead system at a pressure of at least 3,000 volts.

D

PNEUMATIC COAL-HANDLING PLANT.

THE BANKSIDE INSTALLATION.

Only during the past two or three years has the pneumatic system of handling coal, oxide, flue deposits, &c., received much attention from electric power station authorities and other large users of coal. It has long been known, however, that the pneumatic system is applicable to the handling of a very large proportion of

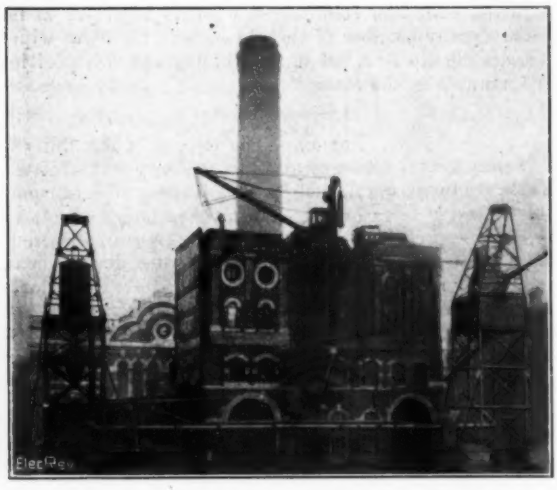


Fig. 1.—Pneumatic Coal-handling Plant at Bankside

industrial coal, but many causes—mainly, no doubt, the relative cheapness of casual labour in the past—have delayed its adoption on a practical scale.* But times and conditions have changed, and any method that tends to reduce labour charges is bound to receive close attention from the management of industrial concerns.

With a pneumatic plant the only labour required is that for the manipulation of the pipes and, further, the pneumatic plant works the whole time; there is no waiting for the "return empty," as in the case of the grab, or skip. Also no trimming is necessary; thus expensive and laborious work in that direction is done away with. The usefulness of the pneumatic method is not by any means limited to the discharging of ships and barges; it is invaluable in all those cases where the application of ordinary straightforward mechanical elevators and conveyors is difficult, or impossible. A pneumatic plant may be used, for example, for the removal of coal from dumps, or from railway wagons, and for the transporting of coal over intervening roadways, canals, or other obstacles. When transport from a fixed point to a dump, or other more or less extended area, is required, a pressure or blowing system, acting on the same principle, may be employed.

Every suction conveying plant, no matter how it may be elaborated to suit the conditions, comprises the following elements:—

(1) The conveying pipes through which the material (coal, grain, &c.) is conveyed by a current of air.
(2) The vacuum pumps and their prime mover to produce the aforementioned current of air.
(3) The receiver, or expansion chamber, in which the material is deposited in consequence of the diminution of the speed of the current of air.
(4) The discharging mechanism for extracting the material from the expansion chamber without loss of air.
(5) The dust separator, for cleaning the air before returning it to the atmosphere.
(6) Air piping connecting the receiver to the dust separator, and the dust separator to the vacuum pump.

* See Elec. Rev., December 2nd, 1921, p. 762.

Important progress has been made in the development of pneumatic plant for dealing with various materials by Messrs. Henry Simon, Ltd., Manchester, and an interesting example of their work is the pneumatic coal-handling plant recently installed by that firm at the Bankside electricity generating station of the City of London Electric Lighting Co., Ltd.

This installation comprises two units, each capable of handling 60 tons of coal per hour, and is said to be the largest of its kind in the world. Each unit consists of a braced steel tower, fig. 1, 65 ft. high, containing a receiver and tipper seal, whilst the pneumatic pumps are housed alongside No. 1 tower. A 12-in. diameter pipe boom is connected to each receiver, each of the latter being 15 ft. deep by 6 ft. 3 in. in diameter, by means of a swivel joint which provides for the lateral movement of the boom. A length of 8-in. diameter flexible piping with telescopic sections and a suction nozzle is coupled up to the end of each boom, and hand-winches are fitted for controlling the luffing and telescopic movements of the pipes. The booms are of such a length and the receiver towers are so placed that the pipes can command eight Thames lighters lying at two berths four abreast. This is an excellent example of the flexibility of the pneumatic system.

The suction nozzles are plunged into the coal, which is at once sucked into the pipe, and is delivered through tipper seals on to band conveyors which transport the fuel to the bunkers. The conveyor bands were formerly fed by the grabs used for discharging the coal from the lighters. This method of employing the pneumatic plant for the difficult part of the work in conjunction

Fig. 2.—Vacuum Pumps.

with ordinary band conveyors for transferring the material from point to point, is recommended by the makers where its adoption is practicable.

The pneumatic installation is operated by a twin-cylinder double-acting pump, fig. 2, driven by an electric motor of 240 h.p., each cylinder being connected to its respective receiver, so that it is possible for one unit to be discharging coal whilst the other is not in use.

The vacuum pump, which has cylinders 49 in. in diameter and a 16-in. stroke, has been designed specially for this class of work, and is of the vertical pattern with valves situated in the top and bottom covers. The valves are composed of single steel disks of special material, mounted on spindles with light springs. The pump is designed to give a high efficiency with a low vacuum, or small pressure difference of from 7 in. to 12 in. of

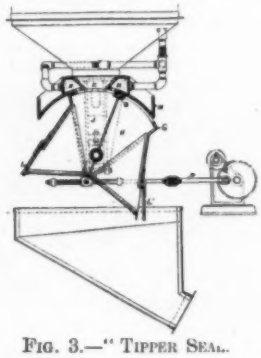


Fig. 3.—"Tipper Seal.

mercury, and is constructed so as to be unaffected by any coal dust which may be carried over in the air. The piston is not lubricated in the ordinary way, but to prevent any unnecessary friction the cast-iron piston rings carry a special dry graphite composition which requires little or no attention.

The suction nozzle employed is of special construction, being rectangular in shape, 24 in. by 5 in., and is fitted with an adjustable air valve for admitting secondary air.

The total vertical lift is approximately 60 ft.; the pipe is fitted at its bend, where there is the most wear, with a renewable plate of special form. It may not be evident how it is that coal can be sucked up to such a height. The fact is, however, that it is not entirely due to suction. A large quantity of air is, of course, drawn up in addition to the coal and its speed in so doing is sufficient partly to drag and partly to force the coal upwards. The coal handled at Bankside is in the form known as "nuts" and "slack." The class and condition of the fuel affect to some degree the efficiency of the plant, and the size of the coal must of necessity be small; it is usual to specify 2 in. as the maximum size, but if the suction pipe be not too small and the proportion of small coal be large, lumps of from 4 to 6 in. will be carried through without difficulty, but fine dust may cause trouble if it is very wet.

The horizontal distance from the nozzle to the receiver may be about 90 ft.; from the boom elbow the pipe diameter is increased to 10 in. and finally to 12 in. The suction piping is telescopic and enables the height of the nozzle to be varied to the extent of from 10 ft. to 15 ft. according to the level of the material in the barge; the upper pipe slides into the lower one, thus preventing the material falling between the joint and causing jamming. The lower end of the pipe is raised or lowered by means of wire ropes carried over guide pulleys, and the boom is designed for operation at all angles, from horizontal to 45 deg.; it is raised or lowered by hand-operated winches. The receiver is divided into three parts, the middle one of which is connected by means of a 16-in. pipe to the vacuum pumps, which cause the coal to be drawn up. The receiver contains a nest of vertical fabric pipes, or filtering tubes, through the fabric of which the dust-laden air has to pass before entering the vacuum chamber, the object being to prevent dirty air from reaching the pumps. The filter pipes are shaken at intervals, so as to cause the coal dust that has accumulated in them to fall into the hopper.

The discharging mechanism or "tipper seal," fig. 3, beneath the receiver is a double-compartment rocking air-tight box with a vertical hinged partition O, thus consisting of two pockets, J H, which are alternately brought into communication with K, the outlet from the receiver. Whilst one pocket J is in communication with the receiver it is under vacuum and the hinged door L is held in the closed position by the pressure of the atmosphere. The other pocket H is at the same time swung far enough over to admit air through the feed opening G, and the hinged door L automatically opens and discharges the contents of the pocket into the hopper below, from which it passes to the belt conveyor. It will be noticed that in the upper casting M, air ports N are provided for the purpose of exhausting the air from the pockets before coal is admitted to them, the object being to prevent the inrush of air carrying the coal over into the dust collector.

The seal is made to oscillate through the desired angle by means of a crank and connecting rod P operated by a train of gear wheels Q. Provision is made to prevent damage to the seal should any solid body, such as a piece of iron, become jammed between the cross bar of the tipping box and the lip of the seating.

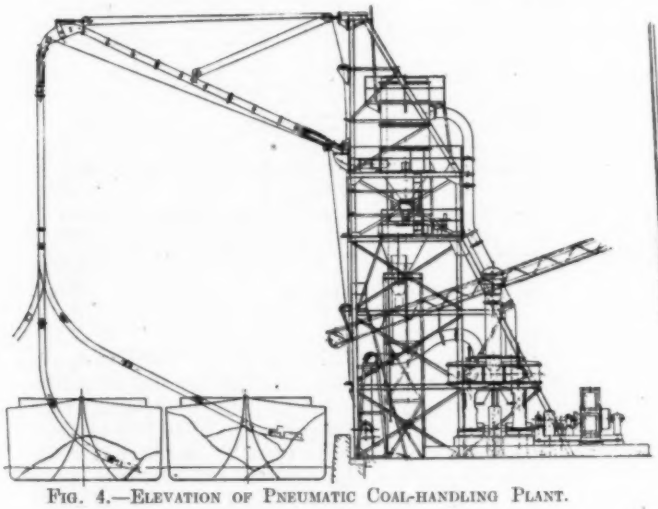


Fig. 4.—Elevation of Pneumatic Coal-handling Plant.

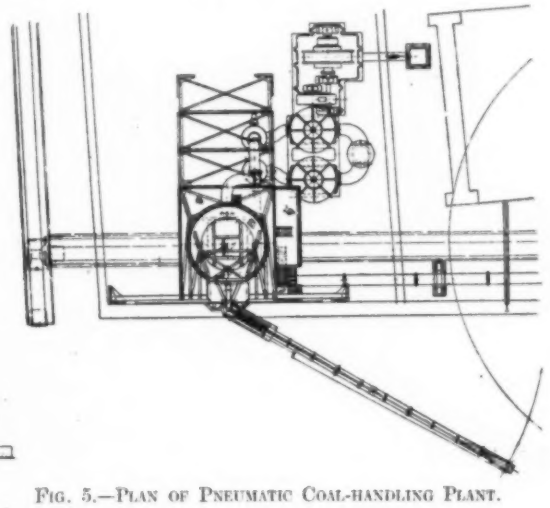


Fig. 5.—Plan of Pneumatic Coal-handling Plant.

Figs. 4 and 5 show respectively an elevation and a plan of one unit of the plant.

Although the pneumatic method of handling coal might at first sight appear to be somewhat expensive, the system offers the advantage of enabling the fuel to be unloaded with great rapidity. Even if the cost per ton of coal transported in this manner were to exceed the cost of handling it by means of grabs, it is claimed that the speed of operation and other advantages gained would more than compensate for this.

Our thanks are due to Mr. F. Bailey, engineer and joint managing director of the City of London Electric Lighting Co., Ltd., and to Messrs. Henry Simon, Ltd., for permission to inspect the plant referred to above and publish the details thereof.

NOTES ON SINGLE-PHASE COMMUTATOR MOTORS.

By N. PENSABENE-PEREZ, M.I.E.E.

As the field of application for electrically-driven apparatus becomes wider, there is an increasing demand in this country for a single-phase motor which, unlike the induction type, has the following features:—

(1) A powerful starting torque.
(2) A moderately small current at starting.
(3) A simple starting switch.
(4) A good power factor.
(5) A good range of speeds by simple control.

It is well known that none of the above features are natural qualities of the induction type of motor, and when the second feature, which is possible, is insisted upon by the electricity supply authorities the use of slip-rings and complicated starting gears makes the cost of the motor quite prohibitive.

The single-phase commutator motor of small size having series or shunt characteristics deserves greater favour from power users than it has had up to the present, because, apart from the above features which it possesses, it is a simple, reliable, and inexpensive machine.

The plain series type, on account of its great simplicity, should be used in preference to the constant-speed type, and in case of small power its series characteristic does not debar its use in most applications when the apparatus driven takes such a good percentage of power, even when doing no useful work, as prevents the motor from reaching inadmissibly high speeds.

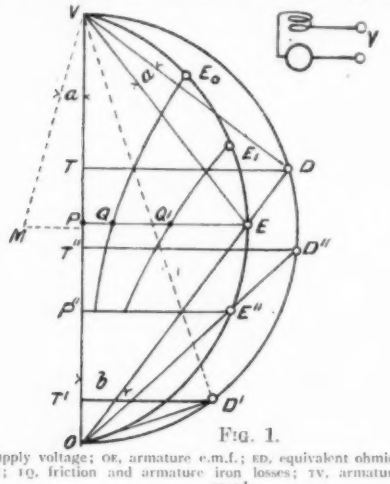


Fig. 1.

ov, supply voltage; oe, armature e.m.f.; ed, equivalent ohmic drop; qe, motor output; iq, friction and armature iron losses; tv, armature torque; oe/ev, speed.

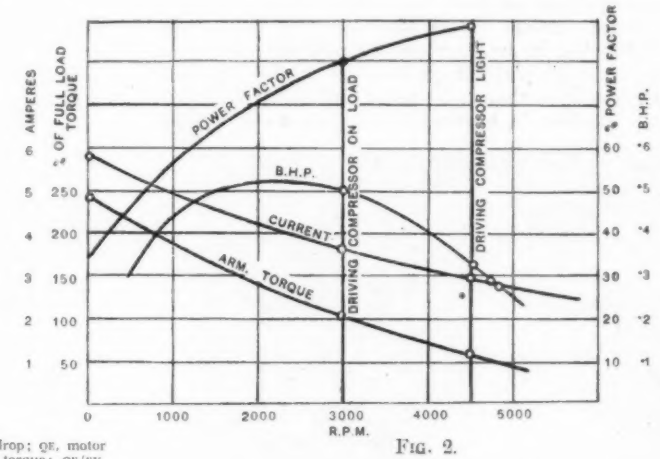


Fig. 2.

To calculate the maximum speed when running light it is necessary to know the characteristic of the motor as well as the power necessary to drive the apparatus light at different speeds. As this is a vital question upon which the adoption or rejection of this type of motor depends, the following consideration may perhaps be found of some use.

Let us first consider the diagram connecting voltage, current, power, and speed of such a motor when the internal losses in it are taken into consideration. In fig. 1 the supply voltage is represented by the vector ov, while oe represents the e.m.f. induced in the armature by rotation. The flux being in phase with the current, oe will also be in phase with the current.

The impedance voltage of the armature and field is at 90 degrees to the current and represented by the vector dv, which also represents the current magnitude. The vector ed represents the voltage drop due to the total resistance duly increased to take into consideration the iron losses in the stator core as well as the losses in the short-circuited coils and brushes. This rough way of taking into account these iron losses can be justified by the fact that we can assume these losses to vary approximately as the square of the flux and therefore with the square of the current just like copper losses.

The power input is proportional to ov . dv $\cos b$ = ov . td, or to the segment td, because ov is constant. The power taken by the armature consists of the useful power, plus friction and armature iron losses. This power is given by the product of the e.m.f. with the current or by oe . dv = ov . pe, or by the segments pe. It is clear that all points like d move in a circle, having ov as diameter.

Now, ed being proportional to the current like dv, the angle a is constant, therefore the points like e move also in a circle, the centre of which m can be found, as clearly shown in the diagram. If the friction and armature iron losses are represented in the scale of power by the segment pq, then qe represents the motor output. The armature torque (including friction and iron loss torque) being proportional to the square of the current is represented by the segment tv. The e.m.f. oe being proportional to the current multiplied by the speed, and the current being proportional to the segment dv or ev, the ratio oe/ev is proportional to the speed which therefore it can represent.

For any working condition fixed by points like e, the speed can thus be found and the friction and armature iron losses plotted, thus obtaining the curve qe_0, which cuts the circle oev in the point e_0, fixing the no-load conditions and the maximum speed the motor will reach when running light. With the exception of very small fractional-h.p. motors, this no-load speed is generally very high as compared to the full-load speed; therefore this type of motor can only be recommended in cases when the friction in the apparatus driven constitutes a considerable proportion of the motor load. This condition is generally fulfilled when very heavy reduction gears are used or in the case of heavy shafting, low-speed machine tools, air compressors, &c.

The diagram we have been tracing is the working diagram of a ½ b.h.p. 3,000 r.p.m., 50 cycles, 200 volts series motor made by the Electro-Dynamic Construction Co., London, and driving by means of a chain an air compressor running at 500 r.p.m. (fig. 3). In a case like this, such type of motor is obviously most suitable, as it gives a powerful torque to start the compressor against full pressure, with a relatively small starting current and without any danger of running away when the compressor works against atmospheric pressure. Moreover, a tumbler switch is all that is required for

starting the compressor. The power factor is also satisfactory.

In order to find the working conditions of this motor when driving the compressor, the curve $Q_1 E_1$ has been plotted by knowing the total friction losses, QQ_1 of the compressor and chain at different speeds. This curve will cut the circle OEV at E_1, which will give the running-light speed, current, &c.

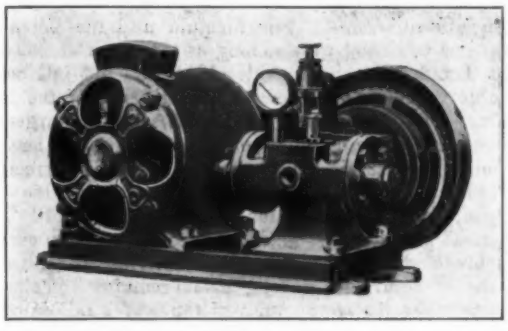


Fig. 3.

In fig. 2 the current, torque, output in b.h.p., and power factor have been plotted as functions of the speed with the usual co-ordinates in order to give the results at a glance. The a.c. series commutator motor is at its best when working above synchronism, as far as sparking troubles and power factor are concerned. However, for a small output it is possible to run this motor considerably below synchronism with fairly satisfactory results. The speed regulation of a series motor can be accomplished practically without loss of power either by varying the voltage applied by means of a graduated auto-transformer or by means of a variable impedance diverter across the field winding.

The diagram shown for a voltage v will hold good for any voltage k . v if we read the current and volts as before, but in this ratio k, and the torque and power in the ratio k^2. The scale of speed will be as before, being given by a ratio of voltages.

Thus, if we wish to know the speed of the motor in question when supplied at, say, 160 volts and giving the full-load torque as before, we have to trace $T''V = TV\ (200/160)^2$, and get the working points D'' and E'', from which we can read a speed equal to 1,630 r.p.m., as given by $OE''/E''V$.

It will be seen that a small voltage reduction will give a very large reduction in speed for the same torque. The power factor, however, is reduced from .8 to .67. The use of a variable impedance diverter is less expensive when no transformer is needed for the motor on account of other considerations. The constant-speed type single-phase commutator motor is a somewhat more complicated machine, and its theory not so simple, but it has a greater field of application.

Licensing of Wiremen in Ontario.—A Labour member has introduced to the Provincial Legislature a measure providing for the examination and licensing of electrical contractors and electricians. The *Electrical News* recently published a review of this Bill. The measure is not to apply to employés of public utility companies or authorities, acting under the direction of officers of such authorities. Apprentices are debarred from carrying out installations, except as assistants to electricians licensed under the Act, and under their direct supervision. An examining board, consisting of three members experienced in electrical work, will be appointed, one of whom will be a contractor and one a journeyman electrician. The licences are of four different classes, depending upon the nature of the work to be executed by the licensee and the length of his experience. Every contractor, upon receiving a licence, will be required to deposit a bond as a guarantee of the faithful performance of any installation work he may carry out. Penalties will be imposed upon any contractor or journeyman performing work without being previously licensed.

THE LOCALISATION OF A PARTIAL DISCONNECTION FAULT IN A CABLE.

By HAROLD OHLSON.

It happens occasionally that the conductor of a cable is broken by a momentary strain without injury to the dielectric, and the result may be that the two ends are brought together by the elastic nature of the insulating material, and there is not complete disconnection. The bridge balance will show a total resistance higher than that of the copper conductor, and often very variable.

The method of measuring the capacity from each end to the break gives no result unless the disconnection is complete. The following test, devised by the writer some years ago for use on partial disconnection faults, requires no special instruments or complicated connections, and in practice has been found to give satisfactory results. As described below, it is adapted for tests on the comparatively short lengths of cable dealt with in the factory.

A preliminary bridge reading with a low battery power will give the resistance offered by the broken conductor, and by subtracting the resistance of the copper, known by former tests or calculated, the resistance of the disconnection is found. This may vary considerably, but close watching of the bridge balance will give valuable information as to the probable resistance of the break during localisation. By a simple arrangement of connections, the resistance may be watched on the bridge until a favourable moment of steady value is observed, and then the cable is at once plugged to the localising battery and the galvanometer throw noted. The interval between the bridge reading and the completion of the localisation test, especially if only one throw is taken, need not be more than a few seconds.

The connections for the tests are as shown in fig. 1.

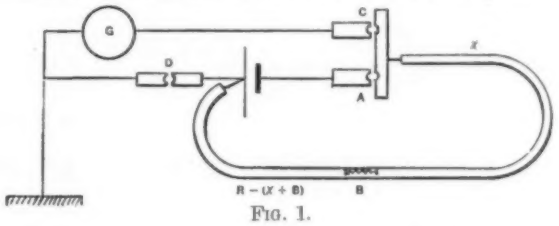


Fig. 1.

where R = total resistance of broken cable circuit,
B = resistance of partial disconnection,
x and $R-(x+B)$ = the resistances of the two parts of the conductor.

A single cell of constant e.m.f. and very low resistance is required for the test, and the connections, especially that at A, must be of negligible resistance.

For the first operation the end of the cable shown in the diagram as connected to the carbon pole of the battery, is freed from it and insulated. Connection is made at D to earth the battery, and the discharge from the cable, after charging it to the full battery potential, is observed by changing the connection from A to C. This observation need be made once only, as it remains constant as long as B is sufficiently low to make a test for partial disconnection necessary.

The connections are then arranged exactly as in the diagram, in order that the cable may be charged by a potential falling along the resistance of the copper and that of the break. Connections are made at D and A, and then the following operations are performed in quick succession but exact order; the earth is disconnected from the battery, the battery pole to line is disconnected from the cable, and the cable is discharged through the galvanometer. The throw obtained is a measure of the quantity of charge resulting from the capacities of the two parts of the cable and the potential charging them, this potential being governed in its fall by the copper resistance of the two parts of the cable and the resistance of the break. A second observation may afterwards be made with the cable ends reversed.

Referring to the diagram, fig. 1 :—

First operation, with cable end free.

(1) Connect at D. (2) Connect at A. (3) Disconnect at A and connect at C. Galvanometer throw = T = full charge.

Second operation, with cable end to battery.

(1) Connect at D and A. (2) Disconnect at D. (3) Disconnect at A. (4) Connect at C. Galvanometer throw = T_1.

Repeat second operation with ends reversed. Galvanometer throw = T_2.

The distribution of potential in the second and third operations may be shown diagrammatically (fig. 2).

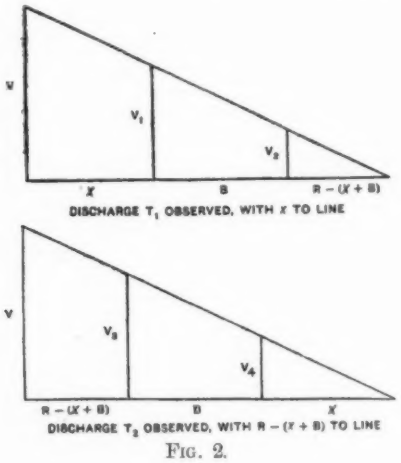


Fig. 2.

Let C_1 be the capacity of the length of cable with copper resistance x, and C_2 that of cable with resistance $R - (x+B)$,

$$\text{Then,} \quad \frac{C_1 \text{ charged to } \frac{1}{2}(V + V_1) + C_2 \text{ to } \frac{1}{2} V_2}{C_2 \text{ charged to } \frac{1}{2}(V + V_3) + C_1 \text{ to } \frac{1}{2} V_4} = T_1/T_2$$

But as potential, resistance, and capacity (of a cable) are interdependent, the above expression may be written wholly in terms of resistance.

$$\frac{\frac{1}{2}x(R + R - x) + \frac{1}{2}(R - x - B)(R - x - B)}{\frac{1}{2}(R - x - B)(R + B + x) + \frac{1}{2}x(x)} = T_1/T_2$$

$$\text{whence } x = \frac{T_1/T_2 (R^2 - B^2) - (R^2 - 2RB + B^2)}{2B(1 + T_1/T_2)}$$

where x = ohms of conductor to break from end to line when T_1 is observed.

An examination of this formula and the potential diagrams will show that as long as the break resistance, even though it varies considerably, does not fall below a value which is high compared with that of the conductor, the proportion between the two discharges T_1 and T_2 gives very closely the proportion of the lengths of cable on each side of the break, and the correcting formula may be disregarded. In many cases this will happen, and a localisation sufficiently accurate for practical purposes is made very quickly and easily. The break resistance need not be determined with any degree of accuracy, so long as it remains sufficiently high to make the conductor resistance of small importance.

The potential diagrams also show that if the break resistance does not change between the observation of T_1 and T_2, then $T_1 + T_2 = T$, and it is not necessary to reverse the cable ends, T_2 being $T - T_1$. With a rapidly varying break of low resistance it may be found better, after determining T, to take a number of observations of T_1, each immediately after a bridge reading, and deduce T_2, but a test with reversed ends is a valuable guide to the behaviour of the break and the condition of the battery and connections.

If the ends of the cable cannot be connected directly to the instruments in the test room, the leads must be considered as part of the cable circuit, but if an assistant is available the battery may be joined directly to the cable in the factory and only a single lead used (from C to G) to convey the discharge through the galvanometer in the test room to earth.

BROOKHIRST AUTOMATIC MOTOR-STARTING SWITCHGEAR.

Not content with improving their hand-operated starters by the adoption of the drum-type controller, which we described in our issue of January 27th, 1922, Messrs. Brook, Hirst and Co., Ltd., have now brought out a solenoid-type automatic motor-starting panel which presents novel features. In general form the panel is similar to the hand-operated gear, but the starter movement and the method of controlling the rate of starting are new departures. Sliding contacts and contactors are replaced by a device which, it is claimed, embodies the advantage of numerous steps which characterise the one and that of butt contacts which is possessed by the other.

In the "Brookhirst" solenoid-type starter, illustrated in fig. 1, the fixed contacts are of carbon, mounted in stamped holders. Behind each carbon is a spring which ensures the requisite pressure between the fixed and moving contacts. The moving contact consists of a bar actuated by a single solenoid, but in such a way that it approaches each carbon with a direct butt movement, so that contact is established instantaneously over the whole area of the carbon. In the course of its further movement the bar presses the carbon home into the holder, and subsequently there is a slight sliding movement which tends to clean the contact surfaces. This action is repeated on each step and, there being one solenoid only, it is possible to provide economically an ample number of steps.

The advantages of this movement are several. With designs employing a sliding contact, there is a noticeable tendency when starting up for the starter arm to stick, owing to the contacts becoming pitted; such a tendency is, of course, eliminated in the design under consideration, and the necessity for constant supervision and adjustment is thus avoided. The number of starting steps being always adequate to the output, the acceleration of the motor is gradual, and it benefits by the elimination of excessive current peaks. The absence of arcing on the contacts means that they require renewing at long intervals only.

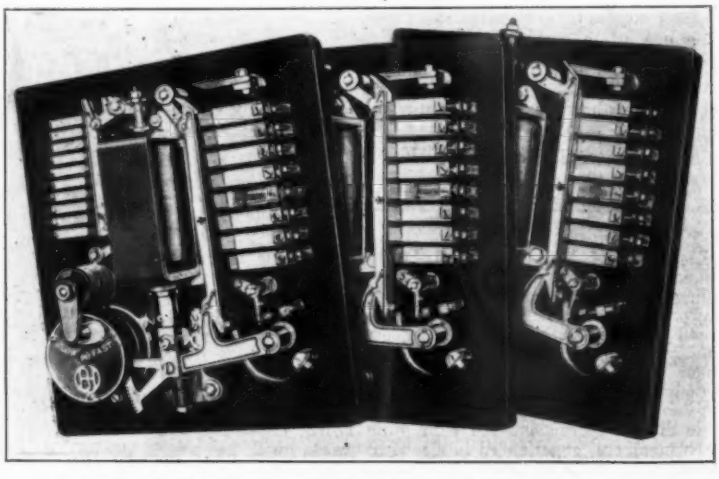


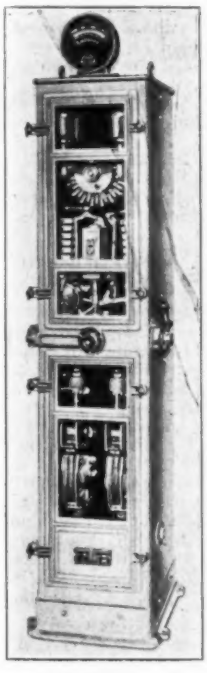
Fig. 1.—"Brookhirst" Starter Mechanism, in Three Positions.
Sliding movement indicated by arrow-head on contact bar.

The timing of the starter movement is effected by an eddy-current retarder. The solenoid plunger, acting through a rack and train of gears, causes an aluminium disk to revolve between the poles of an electromagnet excited by the main

armature current. The eddy currents generated in the disk exercise a braking effect upon it and upon the plunger. As this effect varies in direct proportion to the starting current, the retarder provides the vital characteristic of quick starting with light loads and slow starting with heavy loads. Unlike the oil dashpot, the retarder is unaffected by dirt or temperature changes, nor does it continue to exercise a braking effect when the starter arm is returning to "off." Since the contact springs also tend to force the arm to the "off" position, there is a positive return, with no possibility of the arm sticking on the backward movement. Apart from the automatic variation of the braking effect with the load, it can also be adjusted for normal starting conditions by regulating the distance between the poles of the electromagnet.

The possibility of governing the movement of the starter electromagnetically in this way, instead of by a dashpot, means a very great increase in reliability. A heavy overload during starting may result in a complete interruption, temporarily, of the starting operation, thus avoiding an excessive rush of current such as might damage the motor. And, finally, the lack of any necessity for constant attention and adjustment effects a by no means negligible saving of time on the part of the maintenance staff.

The starter is not normally arranged for "inching," though this may be carried out by the use of the "start" and "stop" buttons in sequence. Where, however, this operation is to be an important function of the starter, a special inching feature is embodied. This enables inching to be effected without the starter arm coming into action. The



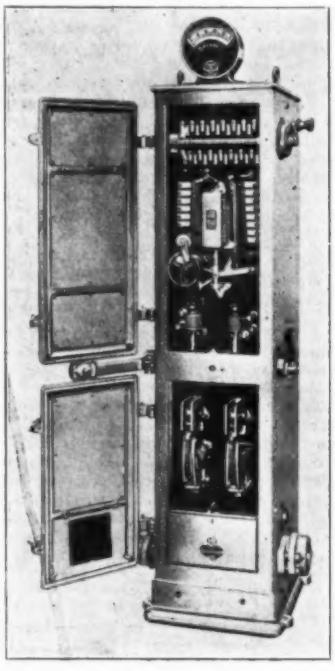


Fig. 2.—Starter with Solenoid-operated Speed Regulator.

Fig. 3.—Starter with Hand-operated Speed Regulation; Doors Open.

"Brookhirst" Solenoid-type Motor Control Panels.

inching current can be varied within prescribed limits by means of links and terminals which are provided.

This starter constitutes the central feature of an ironclad panel which comprises, in addition, a double-pole circuit breaker and a double-pole isolating switch. The former, consisting of two magnetic blow-out contactors and two adjustable solenoid-type overload trips, provides complete protection for the motor both during starting and running. The isolating switch, which is fitted in a sealed compartment with external operating handle, is interlocked with the doors in such a way that the latter cannot be opened or left open unless the isolator is "off" and the panel "dead."

For certain applications (*e.g.*, printing presses) it is not as a rule necessary to effect speed changes at the work itself, but the speed having once been set it must be possible to start, stop, and "inch" the motor frequently, the speed at each restart always reaching and finally remaining at the set speed. In such a case a regulator of the automatic acceleration type, as included in the panel illustrated in fig. 3, is used. The regulator is adjusted by hand to the required speed, if necessary while the work is in progress. On restarting, after normal speed has been reached, the motor automatically accelerates to the speed which has been set. The accelerator bar and contacts which achieve this object (shown on the left of fig. 1) also cut out the whole of the shunt resistance on stopping, so that on restarting or "inching" it is not necessary previously to bring the regulator handle to the "all resistance out" position.

There are some conditions, again, in which it is desirable to have complete control of the speed by push buttons at the working position. For these applications a panel such as that illustrated in fig. 2 is employed. The regulator in this case is of the automatic type, operated by two solenoids, and it is possible from a convenient push-button station to start, stop, "inch," accelerate, or retard the motor.

It is also possible to employ a third system of speed regulation using a constant-speed panel and a separate hand-operated shunt regulator, which can be arranged either with a pedestal, or for wall mounting, and can thus be placed in close proximity to the work. This arrangement is intended for applications where it is necessary to effect speed adjustments at the work itself, but not to start and stop frequently. Each time the motor is started or "inched," the regulator must be brought to the "all resistance out" position, and when normal speed is again attained the regulator must be readjusted to give the required speed.

The push buttons for controlling these automatic panels can be arranged in the most convenient manner for each application. It is usual for a set of buttons to be fitted in a single box, constituting a control station; this would comprise five buttons (start, inch, accelerate, retard, stop) or a lesser number depending upon the arrangement. Such a control station can be fixed either to some stationary portion of the machine or to, say, the saddle of a lathe if this is more convenient. Where a separate hand-operated speed regulator is employed, one such push-button station is fitted in the same case as the regulator. Duplicate control stations can be fitted at convenient points on large machines, and, where desirable, emergency stop buttons can be arranged in suitable positions. For flat-bed printing presses the control station takes a slightly different form; two push buttons are included ("run" and "inch"), and the motor is stopped by a lever which may be quickly knocked off in either direction.

In addition to these arrangements of push buttons, panels can, of course, be controlled by a float switch or some other form of self-acting master switch for pumps and similar applications.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR MARCH, 1922.

The March official figures of electrical export business show an increase of £121,808 on the February totals, but a decrease of £254,887 as compared with the January return. The value of electrical machinery exported during March was £92,000 in excess of those for February, increases also being recorded in the sections for electrical goods, glow lamps, batteries and accumulators.

The total tonnage of electrical machinery exported during March was 1,896 tons, as compared with 1,720 tons in March, 1921. Electrical imports and re-exports totals for March show a falling off in value of £35,000 and £6,000 respectively.

Values of Electrical Exports and Imports for March, 1922.

	Exports £	Imports £	Re-exports £
Electrical goods and apparatus (unenumerated)	113,573	47,229	4,821
Insulated wire	147,037	19,457	724
Glow lamps	38,349	11,547	9,063
Arc lamps and parts	2,364	1,081	—
Batteries and accumulators ...	47,520	8,670	5
Meters and instruments ...	33,747	3,674	572
Carbons	3,502	5,157	109
Electrical Machinery.—			
Railway and tramway motors	22,554	—	—
Other motors and generators	277,451	—	—
Switchboards (not telegraph or telephone)	15,501	414	—
Electrical machinery (unenumerated)	185,110	136,511	2,098
Telegraph and Telephone Cable and Material.—			
Telegraph and telephone wire and cable (not submarine)	29,839	4,818	1,186
Submarine telegraph and telephone cable	17,773	—	—
Telegraph and telephone instruments and apparatus	180,266	13,463	1,196
Totals	1,114,586	252,021	19,774

Wireless Telegraphists' Dispute.—A meeting between Mr. Ward, chairman of the London District Association of Engineering Employers, representatives of the Marconi Co., and of the Association of Wireless and Cable Telegraphists, took place at Broadway House, on April 21st, at which it was agreed that the negotiations, which had been broken off, should be resumed and that the telegraphists should return to duty forthwith.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Rats v. C.T.S.

With reference to the disgusting advertisement of the C.T.S. Co., may I suggest that the particular rodent in question was a self-respecting animal and would not contaminate itself by eating the above firm's evidently disgusting product. It preferred death.

I am of the same opinion, and I shall, personally, never use C.T.S. cable again.

Fairplay.

April 22nd, 1922.

The advertisement issued by the St. Helens Co. showing the starving rat, with humorous comments, recalls to one's mind the stories of the brutalities which used to sicken us during the war. Then there was at any rate the excuse that they arose from war passions, but there is no such excuse for the torture of the rat. That comes from even more ignoble reasons.

The advertisement debases the name of Englishman throughout the world. It is a new and horrible development in advertising which I trust will come to an instant end.

The plea that there is a scientific value in the experiment will not hold. The fact that a starving rat, in a cage, would not touch the cable does not prove that rats will not touch it under other conditions.

I beg leave to sign myself

An Englishman.

April 22nd, 1922.

The correspondents who, in your last week's columns, waxed so nobly indignant anent the sad death of a rat for "the purpose of filthy lucre," would surely do better to reserve their wrath—and their energies—and to train the guns of their censure on things that really matter. Why this outcry concerning an unloved rodent, when there are untold numbers of the genus "Homo" dying to-day in a similar manner (and scarcely a word said) who might be spared such "cruelty" by a mere tithe of the "filthy lucre" which a civilised world spent on the recent holocaust of destruction?

Herein, I would suggest, lies far worthier scope for their "humanity," if such is genuinely the flag under which they are sailing!

Sense of Proportion.

Can "Disgusted" or "Completely Disgusted" suggest a less cruel but equally efficient method of proving if rats attack c.t.s.?

Can "Disgusted" give fuller details to prove his statement that rats destroyed a considerable amount of c.t.s. on a whaler, so that this allegation may be worth consideration? His signature would also be useful.

J. H. C. Brooking.
St. Helens Cable & Rubber Co., Ltd.

Warrington, *April 24th*, 1922.

[Several letters on this subject have been received, too late for insertion.—Eds. Elec. Rev.]

Employers' Agreements.

Now that certain groups of employers are going the length of closing down half the engineering works in the country on the pretext of groups of workpeople (through their unions) interfering with what they consider to be their rights, it does not seem inappropriate to ask them when they propose to cease interfering with the rights of their workpeople.

The interference I refer to is the practice amongst certain groups of firms in the electrical industry (I believe practically all in the B.E.A.M.A.) of not taking each other's employés.

On the surface this looks a very simple, innocent and unobjectionable arrangement between firms (each of which suspects the other of plundering it!), and possibly was originally made without any ulterior motive, but what does it become in practice? An employé of firm A applies to firm B for a job. Firm B first of all asks firm A if it is willing to release him, and secondly, what it thinks of him. If firm A is willing to release him, firm B assumes he is no good, and he hears no more; if firm A is unwilling, the result is the same, but he is a marked man—if no worse.

Many of us have had to take quite unsuitable berths since the war, and in this way we are kept in them to our own and our employers' and our country's detriment.

The simple economic aspect of the question is this: **if firm B** can afford to offer a man better pay than firm A, it is either due to firm B's better management (neglecting any little inequality in that all-pervading attribute greed) or to the man's greater suitability for the work that firm proposes to give him, and, apart from the unwarrantable interference with the man's liberties, it is not good that firm A should continue to monopolise a man and not fully use him; it is equally bad that firm B should be deprived of the chance of making better use of him, and it is beyond all reason that a man should not be free to sell his services to whomsoever he chooses (or has the opportunity) in the same way as the products of his services are sold by his employer.

There are at present many "square pegs in round holes," and it is certainly not to any employer's interest to keep them there against their inclinations.

No man with common sense wants to change a "crib" in which he is comfortable and has ordinary prospects, and no employer who knows his business wants a man who is not satisfied.

Why, then, do these groups of employers continue this objectionable practice, which benefits nobody, hinders reconstruction, damages national industry, and oppresses the King's subjects? And why are they allowed to?

Pollux.

April 24th, 1922.

[We have ascertained from the secretary of the B.E.A.M.A. that there is no such practice amongst groups of firms in that Association.—Eds. Elec. Rev.]

The Lock-out.

Also a constant reader for 20 years, I agree with Mr. Heasman that it is evident that Sir Allan MacGregor Smith, the chairman of the Employers' Federation, and a Scottish solicitor, is the Jonah of the party. We have had dictators like Napoleon, the Kaiser, and now Sir Allan Smith; had these men only used sanity and put their education to the betterment of the human race, the world would be in a purer state to-day; instead they only create discontent and Bolshevism. We agree that there is no better worker than an Englishman when treated fairly. But for the boys of 1914-15, some of the gentlemen of Sir Allan Smith's type might not have been here, and the dear Germans might have confiscated their property. What then? It would be very interesting to know how much some of them had in August, 1914, and how much they have got in April, 1922, after the glorious débâcle of blood. Personally, I envy no man, respect honest sane men, both good employers and straight workmen, having worked in works and factories all over the country for many years, and do so now. O for sanity and reason, and less of Shylocks!

Constant Reader.

April 22nd, 1922.

Liquid Starters for Three-phase A.C. Motors.

The electrolyte in the above switches is composed of concentrated carbonate of soda (powdered) and water. The tanks are porcelain cylinders with cast-iron ends and plungers, the latter having copper strip conductors attached, and being also immersed in the electrolyte. The switches are *always* in parallel with the short-circuiting switch when motors are running with Kapp vibrators in the rotor circuit; the current is from 300 to 400 amps. Trouble is caused by a non-conducting film forming on the cast iron and the soda crystallising at the bottom of the tanks. There is no similar trouble in other switches where current does *not* pass through the liquid, except for starting up. Can you, or any reader, kindly state the cause, or suggest another electrolyte which will not corrode or injure the copper or cast iron?

Delta.

April 22nd, 1922.

Finding Faults.

I will be obliged if some of your mains readers will give the quickest method of finding faults in direct-current, triple-concentric cables (armoured and lead-covered, laid direct) when no other instruments are available, but a small millivoltmeter. Current for testing could be taken from mains; a three-wire system with inner core negative, middle positive, and outer neutral.

1. Dead short caused by water getting into old pick hole, shorting and earthing all three conductors (lead not bonded at joint boxes).

2. Earth on outside conductor (neutral) only (lead not bonded at joint boxes).

3. Short and earth between outer and middle core (− and +).

The above faults refer chiefly to long triple concentric l.c. and a. feeder cables.

Colonial.

April 22nd, 1922.

Representation of Labour on Joint Electricity Authorities.

Your leading article on this subject in last week's issue is very interesting to me, for, as usual, you have again ably demonstrated that you have, either not the foresight, or the wish to state a case for Labour.

You should be well aware that Whitley Councils are bodies which sit and pass pious resolutions, fervently hoping that at least some of their resolutions will prove acceptable to some of the electricity undertakings in the area. Personally, from actual experience, I am one of the first to agree that Whitley Councils have done an amount of good work—chiefly done in the first year of their inception—also I agree that a number of the employer representatives have on occasion proved themselves to be sympathetically inclined towards Labour, but after all, the following instances will prove that Labour is not at present satisfied with its share of the "control of industry":—

1. Numbers of electricity undertakings definitely refuse to conform to any decision of any Whitley Council.

2. Cases can be cited of employers' representatives who, while sitting as members of Whitley Councils, refuse to apply resolutions of their Council to their own undertakings.

3. The only persons that I have any record of as having violated Whitley Council decisions are employers, the members of the Trade Unions having always conformed to the decisions no matter how unpalatable they have been.

4. The employés in the London area have, during the past 15 months, had reductions in wages averaging over all grades nearly 25s. per week. These reductions, chiefly under the National Sliding-scale Agreement, were forced upon the trade-union side of the National Council by the employers' side, who threatened to put into operation the 12½ per cent. reduction applied to the engineering trades. Mark this carefully, no negotiations, just an ultimatum from the employers' side of the Council who instructed the trade-union side to choose between two alternative methods of wage reduction. Yet now that these heavy wage reductions have taken place, now that we have men employed in power stations who are not earning a living wage, when the trade-union side of a Whitley Council ask for similar reductions in price per unit to consumers, they are told not to interfere in "managerial functions."

No, let all electricity undertakings conform to Whitley Council decisions, let the employers' side of the Councils show a decided tendency to study the welfare of the workers who produce the profits of the industry—then, and not until then, will Labour be content with Whitley Councils. Until that day comes, strikes, lock-outs, and general distrust by the workers will predominate.

Meanwhile, Mr. Editor, the workers will demand that at least a small minority of the members on any J.E.A. shall be their representatives, watching all proceedings, and where necessary in discussion putting forward the view of the worker. Unless this policy is agreed to, the Labour Party of the House of Commons will be sadly lacking in its duty if it allows the Electricity Supply Bill to pass unchallenged.

Worker.

April 24th, 1922.

Joints Behind Switches.

With reference to Mr. Martin J. Coleman's letter in your issue of April 14th on the subject of joints behind switches, he suggests that switch manufacturers should provide on their switches a connection terminal for making a joint in the negative wire instead of this being jointed at the back of the switch, which is unsatisfactory.

We beg to say that we are able to supply, and have supplied for a number of years, such an arrangement on our tumbler switches.

W. J. Line,
Chief of Technical and Design Dept.
J. H. Tucker & Co., Ltd.

Birmingham,
April 20th, 1922.

With reference to the letter from Mr. Martin J. Coleman, Ballaghadereen, published in the REVIEW of 14th inst., we would say that we agree with him, and have for some time been using a switch made up as he suggests. If he cares to give us his full address we shall be pleased to forward him full particulars and prices.

A. Schamasch.
The Expert Electrical Co.

London, *April 22nd*, 1922.

In reply to your correspondent, Mr. Martin J. Coleman, in your issue of April 14th, I would suggest as an alternative to joint-making on negative wires, which is usually carried out in lighting installations wired with twin lead-covered cables, to carry the cables from the distribution board to the nearest ceiling rose, and loop from one rose to another, using 3-plate ceiling roses. A twin cable should then be run between each ceiling rose and the switch base, one wire being looped to the live plate, and the other, the switch wire, being connected to the spare plate. The pendants could then be attached in the usual way between the negative and switch plates at the ceiling rose. This method would provide an efficient installation, from which extensions could be carried out quite readily, and at the same time eliminate all joints.

I have carried out many installations by this method, as well as by the method of jointing behind switch bases, and in all cases the work has stood for upwards of ten years without giving any trouble.

In jointing behind switch-bases, however, it is essential that the joints should be mechanically sound, and afterwards properly soldered and insulated.

Horace J. Arthur.

Wolverhampton.
April 22nd, 1922.

Correct Recognition of Pioneer Work.

An old Brush colleague of the writer's has sent from Los Angeles a 95-page pamphlet describing the development of electric power in California. It is full of interesting information, and there are numerous graphs which show at a glance the wonderful expansion of electric power developed from water, especially for pumping and irrigation.

The purpose of this letter, however, is to draw attention to a statement made by the editor of *The Journal of Electricity and Western Industry*, which read as follows:—

"About a hundred years ago, to be exact, in 1830, there lived in this country a young man named Joseph Henry, and it was due to Joseph Henry, an American, that the great laws of electricity became so known that we could harness our water power. A simple experiment will give you some conception of how the thing works, as the saying goes. You are all familiar with what is known as a horse-shoe magnet. Well, Joseph Henry found that when he took an ordinary wire and dashed that wire across the end of a magnet, a current of electricity began to flow in that wire. No one knows exactly why it does, but that was the thing he found. He was the first to discover that law. That is all the thing is, simply a wire dashing across in front of a magnet, causing a current to go alternately back and forth in the city far away. And, by the way, it is interesting to note that Henry never got the credit for that law. A man over in England by the name of Michael Faraday one year later published this law, and in late years it has become known as the Faraday-Henry law."

There is, of course, some truth in the above, but the attempt to belittle Faraday is too obvious to be passed over. Such crude statements must necessarily create a certain amount of annoyance.

I think it would be a useful thing for the Institutions of Electrical Engineers, in this country and U.S.A., and possibly other countries, to have committees of elder men who would consider the records of any important achievement. They might file for future reference important documents, records of tests, and working drawings and sketches, which would establish beyond doubt any claims for recognition made by a pioneer or by the pioneer's descendants. For many years the late Dr. Silvanus Thompson did this useful work, but there does not seem to be anyone to follow him, and I think the time is ripe for it to be done by official committees.

The recent discovery of the early apparatus of the late Prof. Hughes is a case in point. Fortunately, Mr. Campbell Swinton and the trustees have acted promptly and with knowledge and thus saved these otherwise crude bits of apparatus for posterity to see and wonder at. There are probably other such cases.

In an interesting speech at the Institution of Electrical Engineers' Commemoration Meeting, Col. R. E. Crompton referred in appreciative terms to the inventive work of a former partner of his during the pioneer days. The name was quite unfamiliar to most of the audience, and yet, according to Col. Crompton, he was responsible for many important, but small, improvements.

It often happens that it is the small improvements which count most in big developments. Take, for instance, the introduction of loose oiling rings for the bearings of dynamos in the early nineties. Up to that time pin lubricators had been employed, and the oil had a bad habit of getting on to the commutator. It would be interesting to know who really was the first to introduce this effective method of lubrication from an oil bath immediately under the bearing.

E. Kilburn Scott.

London, *April 21st*, 1922.

The Future of Electric Vehicles.

I notice that I am reported as having stated, in the discussion which followed Mr. R. J. Mitchell's address on "Electric Vehicles," before the Western Centre of the Institution of Electrical Engineers, at Swansea, on the 3rd instant, that I thought the future of electrics would be largely determined by the cost and supply of petrol for the internal-combustion engine.

My remarks have evidently been wrongly reported, for I hold that the advantages of the electric vehicle, in the way of economy, reliability, &c., are such that, whatever may be the price of petrol, it is bound to be increasingly adopted in the sphere of town delivery and transport work.

In the discussion, I put forward these views, and at the same time referred to statements which have of late appeared in technical journals in the U.S.A., devoted to automobile matters, foreshadowing the likelihood of supplies of petrol falling short of the rapidly growing demand, and the probable concomitant increase in the price of that commodity. I pointed out that, where petrol vehicles were at present used for short-distant work in towns and cities, they could, with advantage, be replaced by electric vehicles, and that it was fortunate, therefore, that we had, in the latter, a means of relieving the situation which might be created by a petrol shortage.

The electric vehicle is in the main, of course, the competitor of horse haulage, and only comes into rivalry with other power haulage methods when the latter are employed in services which come within the scope of the electric. Results show conclusively that the latter can perform such work more cheaply and with greater reliability.

F. Ayton.

Ipswich, *April 19th*, 1922.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Briarton" Washing Machine.

In view of the small number of such appliances the advent of a new British washing machine is always to be welcomed. The number of British designs upon the market is almost insignificant compared with the host of American washing machines. The "Briarton" machine, made by Messrs. Arton & Walton, Ltd., Thomas Street, Cheetham Hill, Manchester, was introduced a few months ago, and the makers claim that it is superior to any American washing machine, and much more suitable for the British market. The "Briarton" is of the revolving-cylinder type. The cylinder is 20 in. in diameter and 20 in. long, and is made of heavy gauge perforated zinc bound by tinned brass edging. Motion is imparted to this cylinder by a ¼-h.p. motor and bevel gears. The wringer, which is driven by a geared shaft, has two rubber rollers, each 15 in. long and 2 in. in diameter,

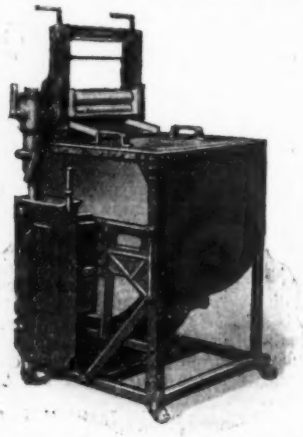


Fig. 1.—The "Briarton" Electric Washer.

quite ample for all ordinary household work. The direction of rotation of the rollers is reversible, and the wringer is swivelled, and may be turned in a complete circle and locked in any position. A reversible drip board is also provided. All fast-running gears are machine cut with helical teeth, and run continuously in an oil bath. The wringer driving gear is enclosed in grease-proof boxes. The control consists of one switch and a lever for each of the two operations—washing and wringing. The motor is fitted with ball bearings and drives through a friction clutch designed to prevent overloading. To facilitate washing by providing ready hot water, a gas burner is fitted under the outer casing of the tank. The machine is compact, it only occupies a space measuring 2 ft. 10 in. by 2 ft. 3 in.

Increasing the Carrying Capacity of a Rheostat.

The following is a method developed at the National Electric Light Association laboratories, Cleveland, Ohio, for increasing the current-carrying capacity of a rheostat. Referring to the diagram (fig. 2), it will be seen that the ordinary sliding rheostat is employed. The free end of the resistance R is, however, brought out to a binding post E, and from this binding post is a connection, with an interrupting switch K, to a point near to the other terminal of the resistance A. A second sliding contact D is also introduced. In operation the ordinary procedure is adopted, with the switch K open, the current entering at A passing through R, the slide C, and

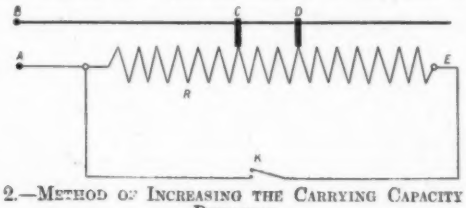


Fig. 2.—Method of Increasing the Carrying Capacity of a Rheostat.

out at B. To increase the current, slide C is moved towards A until it has passed over three-fourths of the distance from E to A. To obtain a larger current, both slides are moved to the centre of the resistance, and the switch K is closed. The resistance will be about the same as it was with one slide and one-fourth of the resistance in use. The current will be divided at A, half of it entering at E and passing out at D, the other half entering at A and passing out at C. To further increase the current, slide C is moved towards A, or D towards E, or the two slides are separated. It is stated that two of these are in use at the laboratories, and it is often convenient to control a current of 50 or 60 A with a rheostat originally constructed to carry 30 A.—*Journal of the Franklin Institute*. Abstract.

"Delas" Air Extractors.

In our issue of October 21st, 1921 (p. 551), we described the principles and construction of "Delas" steam-jet air extractors manufactured in this country by Messrs. Cole, Marchent and Morley, Ltd., of Bradford. We are now able to illustrate an actual installation of these extractors. The three shown in fig. 3 are employed in conjunction with one of a pair of jet condensers supplied by Messrs. Cole, Marchent & Morley, Ltd., to the British Thomson-Houston Co., Ltd., for installation at the Llanbradach (Cardiff) Collieries. Each condenser is able to deal with 82,000 lb. of steam per hour, while maintaining a vacuum of 27½ in. with cooling water at a temperature of 75 deg. F. The air extractors are capable of extracting 170 lb. of air per hour. The injection water extraction pump is of the centrifugal type, having a discharge diameter of 16 in. and a speed of 720 r.p.m. The pump has a capacity

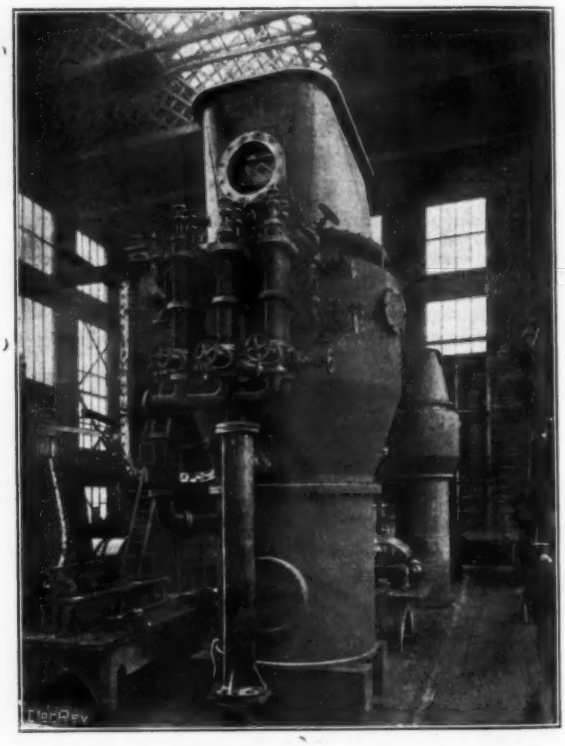


Fig. 3.—Jet Condenser fitted with "Delas" Air Extractors.

of 295,000 gal. per hour and requires 113 h.p. to drive it. The condenser is of the low-level nozzle type, in which the steam passes at high velocity through a series of water jets from specially-designed nozzles, the mixture passing through a converging cone to the bottom of the condenser, from which it is withdrawn by the extraction pump. The air and vapour, rising to the outlet, are extracted from the coolest part of the condenser. A vacuum-breaking valve is fitted; this ensures safety in working, and operates by admission of high-pressure steam to the back of the valve, the admission of steam being controlled by a float. A special feature of the plant is that the valves and pipework are so arranged that any combination of jets can be used or either jet can be completely isolated. The principal dimensions of the condenser are: height to top of condenser shell, 12.5 ft.; height to turbine exhaust outlet, 17.5 ft.; and external diameter of condenser shell, 7 ft.

An Electric Motor Bicycle.

Two years ago at a motor-cycle exhibition held in Italy, Signor Giordani exhibited an electric motor bicycle which attracted considerable attention. The machine was, however, not then in a practicable stage; it has since been improved, and has lately been put on the market by the Officina Meccanica Elet-

trica Ome, of 8, Via della Signora, Milan. While closely resembling an ordinary petrol motor-cycle, a d.c. electric motor rated at ¼ h.p. is mounted in the position usually occupied by the engine. The spindle of the motor, which runs on ball bearings, is provided with a two-speed gear and drives the rear wheel through a chain, the ratio of the two chain wheels being 1 to 8.

The energy is supplied by a battery of Tudor accumulators carried in spring-suspended aluminium cases at the side of the rear wheel, fig. 4. A hand-opearted brake acts on the front

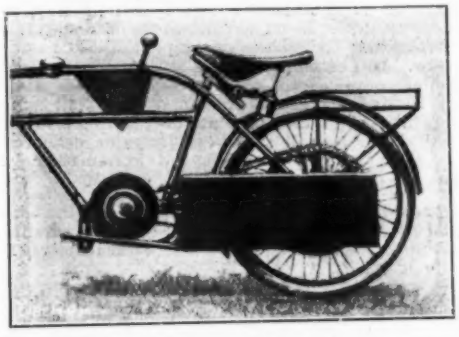


Fig. 4.—An Electric Motor Bicycle.

wheel rim, while there is also a brake on the rear wheel, controlled both by hand and foot, this being so coupled up to the controller that when applied the power is switched off.

The makers do not claim that the new machine, which weighs 198 lb., will compete with motor-cycles of the touring type; on the other hand, they assert that it will meet the requirements of doctors and other professional men who in these days cannot afford to run a motor-car and who do not desire to ride a pedal bicycle. It is stated that the machine can run a distance of of about 60 miles on a single charge, thus enabling the owner to cover more than his usual daily distance at speeds ranging from 6 to 16 miles per hour. The makers also claim that the cost of running the machine is much lower than that of a petrol motor-cycle.

THE ENGINEERING LOCK-OUT.

Since our last issue appeared meetings have been held at which the Executives of the Unions other than the A.E.U., considered a communication from the Engineering Employers' Federation, but they could not accept the latter's conditions as a basis for the resumption of negotiations. It seems that the lock-out notices regarding the members of these unions will not take effect until next Tuesday, so there is yet time for the situation to undergo a favourable change, though there are few indications in that direction.

We quote the following review of the situation as it stood at the beginning of the week, from *The Times*, the writer being the "Labour Correspondent" of that paper:—

"The point on which negotiations have broken down is concerned with the application of the conditionally accepted principle that the trade unions shall not interfere with the right of the employers to exercise managerial functions in the shops, and the Federation shall not interfere with the proper functions of the trade unions. The employers have conceded that when material changes in working conditions are to be introduced the workpeople directly concerned or their representatives in the shop shall be given, if practicable, not less than 10 days' notice of the change and afforded an opportunity for discussion. This is qualified, however, by insistence that the management shall, in the first instance, be entitled to determine what changes in recognised working conditions may be described as material changes. The unions claim that any such decision should be come to jointly, and not by either side without reference to the other.

"Both sides regard the matter as of first importance, and the unions' negotiating committee throughout the prolonged discussion of the past fortnight have pressed the demand that the principle of mutuality should be accepted. The employers, however, take the view that, unless determination rests with them, the exercise of managerial functions in such a way as 'their responsibilities to the industry render necessary,' would be impossible in practice, and they submit that ample safeguards have been offered to secure that no hardship would result to the workpeople involved. No formula has been found which would enable the parties to come to terms on the question, and the issue apparently is to be fought out in the field of industrial strife."

On the same day (April 24th) *The Times* published a brief leader in the course of which it gave expression to the following opinions, which, our readers hardly need to be informed, are those held by ourselves:—

"Common sense, and, we might add, common patriotism, demand from the engineering employers and workmen alike a more accommodating spirit than has been shown in the recent negotiations. We have never believed in the doctrine that these great industrial upheavals are inevitable. On the contrary, we are prepared to trust to the instinctive good will of the two partners in the industrial corporation on which our national prosperity is based. We fear that in the present dispute men of an extreme way of thinking have dominated the negotiations, possibly on both sides. The nation is to-day more than ever suspicious of extreme opinions, and it will not tolerate the fatalistic view which burdens it with avoidable losses. It demands a sound and sensible adjustment of industrial differences, and will applaud those, from whatever quarter they may be drawn, who by the exercise of wise moderation can rescue two of its greatest industries from a plight to which they should never have been reduced."

An official statement was issued by the Employers' Federation, containing particulars of the procedure proposed by it for the avoidance of disputes. The "Special Provisions *re* Material Changes in Recognised Working Conditions," will be found in full in *The Times* (April 24th), as will also statements issued by the Unions, which led to a continuance of the dead-lock.

According to *The Times* Labour Correspondent (April 25th) if there is not definite agreement within the week the fight must go on.

He says that negotiations have reduced the issue to a point which could scarcely be further fined down. The controversy about overtime has receded into the background, and the matter now in dispute is concerned with the right of employers to determine what is and what is not a material change in recognised working conditions in their establishments. It will be necessary to recognise that in the end the real fight which the employers are waging is with the Amalgamated Engineering Union rather than with the associated unions. Unless terms are arranged with the skilled engineers, work for the semi-skilled and unskilled men in the shops would in any case steadily diminish.

On Tuesday the lock-out notices affecting the members of unions other than the A.E.U. were posted in federated shops. It is stated that some 3,000 firms throughout the Kingdom are affiliated to the Federation. *The Times* on Wednesday printed a letter that had been sent by the Engineering Feration to the A.E.U., and the Secretary of the Negotiating Committee of the other unions, stating that the Minister of Labour was being pressed by certain unions to institute a Court of Inquiry under Part II of the Industrial Courts Act, 1919. If such a court were set up the employers would take part in the proceedings, and see that their case was fully brought forward. The employers intimate their willingness to resume the discussion on the questions at issue on the acceptance of the procedure contained in their memorandum, printed in Monday's *Times*, respecting changes in recognised working conditions, but in the event of a Court of Inquiry being set up, the employers will feel that they are no longer bound by the terms of any proposals which have been made by them or on their behalf since the commencement of negotiations. They state that the difficulty which they face at the moment is one in which political issues have been the motive and in which outside, and even international, policy has been the real cause of the present unfortunate state of affairs.

The employers' committee may find it necessary, at an early date, to consider whether, in the interests of the workpeople, the employers, and the industry, it would not be well to intimate generally that for workpeople who are prepared to enter into individual agreement with the employers on the questions at issue, employment will be available.

On the men's side it was proposed to ask the Parliamentary Labour Party to put a private notice question in the House of Commons on Thursday, with respect to the Government instituting a Court of Inquiry.

Cancer Research.—Lord Atholstan, the *Evening News* learns, has written to the Imperial Cancer Research Fund from Ottawa, informing the committee that he has decided to give the £20,000 which he offered early in February for cancer research work to the fund. Lord Atholstan has also offered £20,000 for a medicinal cure for cancer within the next five years. Sir William Church, Chairman of the Fund, was a former President of the Royal College of Physicians. There is a further offer of £10,000 by Sir William Veno, of Manchester, for an effective non-surgical cancer cure.

Corrosion of Condenser Tubes.—A second and revised edition has just been issued by the Corrosion Research Committee, 36, Victoria Street, S.W. 1., of the pamphlet entitled "Notes on the Corrosion and Protection of Condenser Tubes." The document, which is published at 2s. 8d. post free, is intended to be of service to manufacturers of tubes and condensing plant and to the engineers who use them. It is of an essentially practical character, and embodies the results of ten years' research. The first edition of 1,000 copies was exhausted within a week of publication. The new edition contains much valuable additional matter.

BUSINESS NOTES.

Bankruptcy Proceedings.—Eugene Cookson, trading as W. Turnbull & Co., at the Express Magneto Repair Works, as an automobile, electrical and mechanical engineer.—At Blackpool Bankruptcy Court, on April 21st, bankrupt attended for his examination. His gross liabilities were stated to be £932, and there was a deficiency of £630. Debtor attributed his failure to expenses incurred in renovating business premises, pressure by creditors, and money paid for vacant possession of premises. The Official Receiver said debtor filed his petition owing to execution having been levied upon his effects. On demobilisation from the Army, he worked for a firm of electricians for three or four months, and in May, 1919, started on his own account. He then had £30 or £40 as his Army gratuity. He had three removals from premises, and at the time of the last one he had practically no capital, but he borrowed £375 from his friends, £50 of which had since been repaid. For the six months ending September, 1921, he made a profit of £25. He first became aware of his insolvency in March this year. The examination was adjourned.

Aneurin Tudor Williams and William John Bevan, trading as an electrical and general engineering company at 49, Commercial Street, Aberdare.—This public examination took place at the Aberdare Bankruptcy Court on April 21st. The liabilities were returned at £1,708, and there was a deficiency of £1,272. Debtors stated that they started business in partnership in December, 1919, with £100 capital, contributed in equal shares. For the first few months the business went on all right, but the moulders' strike in 1920 caused much difficulty in obtaining materials, and involved them in loss of work. The coal stoppages of October, 1920, and April, 1921, also affected them, and, later, prices had to be cut considerably in order to meet keen competition. In August, 1921, they became aware of their insolvency, but they continued to trade and contract fresh debts in the hope that matters would improve. At this period they were asked by the bank manager to submit a statement showing precisely their position. In that statement they indicated that they expected to receive £1,212. This represented the total value of contracts plus their profits. They did not explain this to the bank, because they thought the statement would be understood in that way. They denied, when closely questioned, that they had any intention to mislead. The examination was adjourned to enable debtors to amend their deficiency account.

John Walker, importer and manufacturer of medical electrical appliances, 9, Thistle Street, Glasgow, carrying on business from time to time as John Walker, as John Walker and Co., as Walker & Co., and as Walker & Nicholson at Glasgow.—Under this sequestration bankrupt's examination took place at the Summary Court, Glasgow, on April 13th. Creditors were to meet in the Chambers of Messrs. David Spalding & Muir, chartered accountants, 190, West George Street, Glasgow, on Tuesday, April 25th. Mr. Hugh Muir is trustee of the estate.

William John Dicken, trading as W. Dicken & Son, 2, Upper High Street, Bargoed, Glamorgan, electrical engineer.—The first meeting of the creditors was held on April 13th at 34, Park Place, Cardiff. Debtor attributed his failure to heavy expenses, depression in trade, and slump in prices. It appeared that he started at his present premises with about £550 free capital, his savings, in October, 1920. He did not think that the business had ever paid. The statement of affairs showed a deficiency of £130. The matter was left with the Official Receiver as trustee of the estate.

Charles Frederick Nason, 93, Butt Road, Colchester, Essex, electrician.—The following are creditors:—

	£		£
Braulik, J.	30	Hands, R. B., & Co.	10
Williams & Co.	20	J. & R. Electric Lamp Co. ...	10
Jeary Electrical Co.	13		

R. T. Morrison, electrical engineering contractor, late of 82, Lumb Lane, Bradford.—Receiving order made April 22nd on debtor's own petition.

R. V. Mayner, electrical engineer, late of Narrow and Wentworth Streets, Peterborough.—Receiving order made April 20th on debtor's own petition.

H. Doyle (Accessories Supply Co.), factor in electrical accessories, 56, Hardman Street, Deansgate, Manchester.—Last day for proofs for dividend May 10th. Trustee: Mr. J. G. Gibson, Official Receiver, Byron Street, Manchester.

Jesse Frederick Ludlow and Robert Redvers Ludlow, trading as Ludlow Bros., 196, Church Road, Redfield, Bristol, electrical contractors.—The first meeting of creditors was held recently at the Official Receiver's Offices, 26, Baldwin Street, Bristol. The statement of affairs showed liabilities of £307, against assets of £53, or a deficiency of £254. Debtors attributed their failure to want of capital, bad trade, and depreciation of stock. It appeared that J. F. Ludlow started business as a jobbing electrician, and in October, 1919, was joined by his brother. They failed to make the business a success, and became aware of their position last March. The matter was left in the hands of the Official Receiver as trustee of the estate. The public examination was held recently at the Guildhall, Bristol. J. F. Ludlow stated that he and his brother started business as electrical contractors with a joint capital of £15, but he afterwards put an additional £35 into the business. After further questions the examination was adjourned.

Frederick Charles Goss, 64, Gloucester Road, Bishopston, Bristol, electrical engineer.—The public examination of this debtor was held on April 21st at the Guildhall, Bristol. The statement of affairs showed gross liabilities of £1,307, of which £1,291 was expected to rank for dividend, and there was a deficiency of £1,022. Debtor stated that in May, 1919, he started in business as an electrical engineer in partnership with a relative. The partnership capital of £50 was provided by debtor. In October, 1919, the partnership was dissolved, and debtor continued on his own account. He denied that he took contracts at cut prices, and said that his prices were the market prices ruling at the time. During the last 12 months the slump in the electricity trade had been enormous. After further questions the examination was adjourned.

Company Liquidations.—Eyquem Sparking Plugs, Ltd.—Winding up voluntarily. Liquidator: Mr. H. Franklin, 30, Garrard Street, W. Meeting, April 28th. Particulars of claims to the liquidator by May 17th.

Maxim Lamp Works, Ltd.—First meetings, creditors and contributories, May 3rd, at Carey Street, W.C.

The B.E. Co. (of London and Birmingham), Ltd., 57, Upper Thames Street, London, E.C., and at Birmingham, wholesale manufacturing electricians.—A meeting of the creditors was held on April 20th at the Cannon Street Hotel, London, E.C., when the representative of the General Accessories Co., the principal trade creditors, was elected to the chair. Mr. Frederick Roland, C.A., of 70, Queen Victoria Street, E.C., stated that the usual resolution for voluntary liquidation had been passed, and he had been appointed as the liquidator. He proceeded to read figures, from which it appeared that the liabilities totalled £9,959, made up as follows:—Trade creditors, £7,240; cash creditors, £2,294; and unsecured balance due to bank, £425. The assets were estimated to realise £7,400, from which had to be deducted £310 for preferential claims, leaving net assets of £7,090. The assets consisted of cash in hand, £17; stocks, £2,864, estimated to realise £2,500; office furniture and fittings, £1,340, expected to produce £500; book debts, £3,541, valued at £2,500; lease of London premises, £20; and unpaid calls, £1,850. The company had two branches in Birmingham—a sales depot and an assembling and manufacturing shop. The Birmingham premises were valued in the books at £3,381, but they were charged to the bank to secure £2,425. The premises might not realise sufficient to discharge the bank's claim, and they had been included as unsecured creditors for £425. The company invested £2,000 in a subsidiary company called the B.E. Manufacturing Co. That company had a nominal capital of £6,000, and manufactured articles for the parent company to sell. At the moment no value had been placed upon these shares. The B.E. Co. (London and Birmingham), Ltd., was registered as a private company on June 22nd, 1916, with a nominal capital of £2,000, and it acquired for £1,000 the stock and fixtures of a business previously carried on by Mr. Fauke in London and Birmingham. The £1,000 was paid by the issue of shares, and there were two signatories to the articles of association. Subsequently shares to the value of £998 were taken up for cash. In January, 1919, the capital was increased to £10,000, and shares to the face value of £4,000 were subscribed for. Finally, the whole of the capital was issued, and the company seemed to have received £9,000 for shares. On November 15th, 1920, the capital was increased to £20,000 by the creation of 10,000 cumulative preference shares of £1 each, bearing interest at the rate of 8 per cent., free of income tax. A number of those preference shares had also been issued for cash. During the year to June, 1917, the company made a net profit of £308, and a dividend of 10 per cent. was declared. The following year the profit rose to £1,062, and there was a dividend paid of 15 per cent. During the year to June, 1919, the profit dropped to £475, but there was a dividend declared at the rate of 15 per cent. Since the inception of the company the total amount paid in directors' fees was only £21. The period to June, 1920, was the most successful in the history of the company, the net profit being £2,412. That amount, however, was not available for dividend owing to the liability for E.P.D., which, however, was never paid owing to the subsequent losses. The troubles of the company began about that time. There was some difficulty with regard to the output, and the factory was purchased in Birmingham. During the year to June, 1921, there was a loss of over £4,000 on the Birmingham factory, and the trading of the company generally for that year showed a loss of £7,000. The present position of the company was due to the loss at Birmingham, and the slump in trade. The company was only a small one, and when it met with misfortune it had no reserves to fall back upon.

In answer to a question, the liquidator said he did not think there was any prospect of a reconstruction scheme being brought forward.

On the motion of the Chairman, a resolution was passed confirming the voluntary liquidation of the company, with Mr. Roland as liquidator, and a committee of five of the principal creditors was also appointed.

Solectric Co., Ltd.—Winding up voluntarily. Liquidator, Mr. F. N. Clarke, 4, Pavilion Buildings, Brighton. Meeting of creditors, April 28th.

Star Electrical Engineering & Manufacturing Co., Ltd.—Winding up voluntarily. Liquidator, Mr. W. R. Boyd, 67, Cleethorpe Road, Grimsby. Meeting of creditors, May 12th, at the Royal Hotel, Grimsby. Particulars of claims to be sent to the liquidator by July 1st.

George England, Ltd.—Winding up voluntarily. Liquidator, Mr. W. Boniface, 10, Serjeants' Inn, W.C. Meeting of creditors, May 3rd, at Anderton's Hotel, Fleet Street, E.C. Particulars of claims to be sent to the liquidators by May 3rd.

Eclipse Carborundum & Electrite Co., Ltd.—Winding up voluntarily. Liquidator, Mr. G. Lord, 62, New Broad Street, E.C. Meeting of creditors, May 5th, at the office of the liquidator, to whom particulars of claims should be sent forthwith.

Dissolution of Partnership.—Bibby & Mottershead, plumbers and electricians, 40, Park Green, Macclesfield.—Messrs. Bibby & Mottershead have dissolved partnership. Debts will be attended to by Mr. Bibby.

Private Arrangement.—Spencer John Tucker, trading as Tucker & Bateson, wholesale electrical suppliers, 55, Berners Street, London, W.—In response to a circular letter issued by Mr. T. L. Summers, accountant, of 64, Victoria Street, S.W., a meeting of the creditors of the above was held recently at Winchester House, E.C. The statement of affairs presented showed liabilities of £1,108, of which £866 was due to the trade, and £242 to cash creditors. After allowing £29 for preferential claims, the assets were estimated to realise £133. It was stated that the debtor commenced the business in 1919 with a capital of £40, but he had since borrowed from relatives, who were now creditors to the extent of £377, but one held securities valued at £135. The business had been carried on at a loss, and the present position was due to that fact. A deed of assignment had already been executed owing to pressing creditors. It was stated that if the deed was accepted by the creditors the cash claims would be withdrawn. A resolution was passed confirming the deed already executed. The following are creditors:—

	£		£
Société Commerciale de l'Appareillage Gardy, Paris	156	Electric Heating Co.	20
Kersons Mfg. Co., Ltd.	97	Heath, Samuel, & Co., Ltd.	23
Davies, Kent & Stewart, Ltd.	70	Aerogen & Co., Ltd.	20
Joseph, C.	67	Langley & Sons, Ltd.	20
Kent, William	61	Boyton, Charles, & Co., Ltd.	16
Townshends, Ltd.	54	Campart, C.	10
Tucker & Edgar	48	Leach, S. G., & Co., Ltd.	10
Falk, Stadelmann & Co.	25	Marshall Electric Co.	14
Johnson & Jorgenson	24	Creditors under £10	118

Sequestration.—The estates of J. L. Brown & Co., electrical engineers, 920, Pollokshaws Road, Glasgow, and J. L. Brown, the only partner of the firm, were sequestrated by the Sheriff of Lanarkshire at Glasgow on April 21st. Meeting to elect trustee and commissioners May 5th, at the Faculty Hall, St. George's Place, Glasgow. A composition may be offered at the meeting.

Trade Announcements.—Mr. H. C. Tofield, A.M.I.E.E., has resigned his position as managing director of Tofield and Robinson, Ltd., electrical engineers, Birmingham, and has commenced business on his own account at Temple Passage, Temple Street, Birmingham. He has been appointed sole agent for "Delco" electric lighting and pumping plants for the County of Warwickshire.

We learn that the business of Messrs. Semco, Ltd., of Shoreditch (in liquidation), has been acquired by the Eastern Armature Winding Co. In addition to its operations at its existing establishment at Shadwell, this company will carry on business at 19-20, High Street, Shoreditch, and 53, Cotton Street, Poplar.

Mr. C. G. Dunster announces that in future he will carry on alone the business of Dunster & Bacon, electrical engineers, of 19, North Holmes Road, Canterbury.

Messrs. Horace Green & Co., motor and dynamo manufacturers, have opened an office at Amberley House, Norfolk Street, London, W.C.2, to deal with home and export business.

Mr. F. T. Hewson, A.M.I.E.E., having severed his connection as superintending engineer with Messrs. Drake & Gorham, Ltd., has now started business, in partnership with Mr. H. V. Lown, under the title of Hewson & Lown, as electrical and general engineers, at 22, Noel Street, Oxford Street, London, W.1. The firm desires to receive copies of catalogues.

In addition to manufacturing electrical machinery and cables, the A.C.E.C., of 56, Victoria Street, S.W., specialise in the production of moulded insulating materials for switch handles and bases, brush spindles, terminal covers and bases, arc shields, &c. The company has recently built an entirely new factory for the mass production of such parts. We have before us a sample of the material in the form of an ash or pin tray.

On Monday next the London offices and stores of Messrs. J. H. Tucker & Co., Ltd., of Birmingham, will be removed from Shaftesbury Avenue to 101, Dean Street, W.1. Telephone number unaltered. The new premises have greatly increased stock accommodation, and they will also provide showrooms where Tucker manufactures (accessories, ironclad gear and switchgear) will be displayed and demonstrated.

Catalogues and Lists.—The Mirrlees Watson Co., Ltd., Scotland Street, Glasgow.—A well-produced booklet illustrating and describing various patterns of central condenser ejector air pumps.

Messrs. Stott Bros., 134, Deansgate, Manchester.—An illustrated catalogue dealing with high-speed wire-covering machines suitable for covering fine conductors.

Messrs. E. P. Allam & Co., 107-109, Gray's Inn Road, W.C.1.—April stock list of d.c. motors ranging from 1 to 38 h.p.

Rotax (Motor Accessories), Ltd., Willesden Junction, N.W.10.—An illustrated catalogue giving details of Newton's d.c. motors and generators.

The Jeary Electrical Co., Ltd., 8, Lambeth Hill, Queen Victoria Street, E.C.4.—A coloured showcard illustrating the difference between house-cleaning by old-fashioned methods and by the "Jeary" electric suction cleaner.

The General Electric Co., Ltd., Magnet House, Kingsway, W.C.2. Bulletin No. 15, "Street Lighting by Gasfilled Lamps."—This publication contains numerous illustrations of the application of various types of G.E.C. lanterns, &c., to the lighting of streets, railway stations, &c. Several examples of lanterns are illustrated and fully described, and a great amount of illumination data, including polar curves, is also included. Installation Leaflet, No. P2,746, giving particulars of stonework cubicle switchgear installed at Southport. (Illustrated.)

Electric Components, Winchester House, Birmingham.—A price list of conduit fittings of all types, including elbows, tees, boxes, couplings, &c.

Simplex Conduits, Ltd., Garrison Lane, Birmingham.—List No. 940, giving particulars, illustrations, and prices of "Simplex" multiple switchboxes, interlocking switch-plugs, watertight switches, and ironclad cut-outs.

Messrs. A. C. Wells & Co., 102-104, Midland Road, St. Pancras, N.W.1.—An illustrated leaflet describing an oil and water separator and waste-oil filter.

Messrs. Gyer, Hill & Gyer, 661-663, Harrow Road, Willesden, N.W.10.—April price list of Government surplus stores of all kinds.

The British Automatic Telephone Installation Co., Ltd., 82, Victoria Street, S.W. 1. A booklet (76 pp.) containing illustrations of the company's apparatus, including wall sets, desk sets, switchboards, indicators, &c.

Catalogues Wanted.—The Artic Fuse and Electrical Manufacturing Co., Ltd., of 66, South John Street, Liverpool, wishes to receive catalogues and prices of British-made electrical apparatus for household purposes.

For Sale.—By direction of the Disposal Board, Mr. C. D. Phillips will sell by auction on May 8th, 12th, 16th and 17th, at Swindon, Newbury, and Didcot, plant, machinery, locomotives, rolling stock, machine tools, electrical plant, cable, and fittings, &c.

By direction of the Disposal Board, Messrs. Oliver, Appleton & Kitchen will sell by auction, at the Central Stores Depot No. 85, Barnbow, near Leeds, on May 16th and following days, engines, boiler, machine tools, electric motors and equipment, fans, transformers, generating sets, &c.

Sale U.D.C. Electricity Department has for disposal a quantity of surplus d.c. generating plant. (See our advertisement pages to-day.)

Australian Metal Export Restrictions.—According to a Melbourne newspaper, the *Commonwealth Gazette* in February contained a proclamation renewing the restriction on the export of certain minerals. It is stated that although in a number of quarters there has been an agitation for the removal of these restrictions, the Federal Government has thought fit to renew them. The Government is desirous that a check shall be kept on the export of metals, alloys and minerals from the country, in order that there shall be no possibility of German combines practically securing control of the Australian base metals industry, as was the case before the war. Unless there are suspicious circumstances, it is explained, the Minister's consent is never refused.

Stoker Contracts.—Among the more important orders recently received by the Underfed Stoker Co., Ltd., are those for travelling grate-stokers for the Eastbourne, Marylebone, Wolverhampton, Stafford, Liége, and Cossipore (India) electricity undertakings.

Economic Conditions in Sweden.—The Swedish Board of Trade, in collaboration with economic experts, has for some time published a quarterly review of the economic conditions in Sweden. As this review contains information which would not otherwise be available to interested parties abroad, it has been decided to publish an abridged edition in English. We have received a copy of the first issue, which covers the first two months of the current year. Copies are obtainable at the office of the Swedish Consulate-General in London, at 329, High Holborn, W.C.1.

Manufacture of Electric Globes in Australia.—According to a Sydney newspaper, it was announced in February that 1,200 men were required by a Sydney factory for the making of electric lamps and globes. It appears that a company had almost completed a very large factory at Alexandria for the manufacture of electrical appliances, principally electric lamps and globes, including drawings and filaments. It was stated that the Labour Exchange could only engage those who had had previous experience. If the experienced labour could not be obtained locally, it might be necessary to arrange for experienced workers to be brought from England. The company, however, desired to give preference to those already in Australia, and those engaged first were to be utilised to a great extent in training Australians for this industry.

New Australian Company.—According to a Sydney newspaper, there has recently been registered in Australia a company entitled Rapid Electric Water-Heater and Steriliser Co., Ltd., with a nominal capital of £15,000 in £1 shares. The company purposes to acquire any patents or copyrights, &c., and to turn same to account. The first directors are W. Stubbs, F. E. Boyden, and W. Plant.

Book Notices.—"Bulletin No. 2, 1921," of the Faculty of Applied Science and Engineering School of Engineering Research, University of Toronto, Section No. 4. "Papers on Current Transformers," by H. W. Price and C. Kent Duff. Toronto: University Press.—The papers cover certain matters regarding ratio and phase-angle errors of current transformers. Copies may be obtained *gratis* from Prof. H. W. Price, Electrical Building, University of Toronto.

Journal of the American Institute of Electrical Engineers. Vol. XLI. No. 4, April, 1922. New York: The Institute. Price $1.

"Electricity," by S. G. Starling. Pp. viii+245; 127 figs. London: Longmans, Green & Co. Price 10s. 6d. net.

"Engineering Abstracts." New series. No. 11, April, 1922. Published by the Institution of Civil Engineers, Great George Street, S.W.

"The Henley Telegraph," March, 1922 (quarterly). London: W. T. Henley's Telegraph Works Co., Ltd. Price 6d. net.—Many sketches, poems, and stories of undoubted literary merit appear in this number. In a list of the firm's recent contracts we note one for the supply of 33,000-V cable to Manchester. The record of social activities is also of interest.

Unemployment.—The total number of registered unemployed on April 10th was 1,718,400, a reduction of 24,117 in the week. The number of workers on short time also decreased by about 5,000. Relief schemes were reported, on April 8th, to have absorbed 135,513 persons.

During the week ended April 17th an increase of 12,110 occurred in the total number of unemployed, but the number on short-time diminished.

Suggestions for the Rio Exhibition.—For the guidance of British manufacturers who, while unable to send samples of their goods, are desirous of being represented at the Centenary Exhibition at Rio de Janeiro, the Department of Overseas Trade arranged, last week, an exhibition of a number of advertising devices. Amongst these were displayed photographic transparencies in natural colours, illustrating jewellery, chinaware, gowns, &c., arranged in stands electrically lighted. Lu-Pal Productions, of Birmingham, exhibited two very effective devices for the display of advertisements or small objects. One of these was a partitioned cabinet, the front of which was covered in with platinum-lacquered glass forming a mirror when unilluminated. In the cabinet were placed models and electric lamps, and when the latter were switched on the models were rendered visible through the glass front. An ingenious automatic alternating switching device was used in conjunction with this. The other exhibit consisted of a box with back and front open, and with a clear glass plate arranged diagonally from the back to the front. In the roof of the box was a translucent advertising design behind which was an electric lamp. When the lamp was switched on a reflection appeared on the glass plate. The "mystery" of the device can be heightened by allowing ribbons wafted by a fan to pass "through" the reflection. Messrs. W. H. Jubb, Ltd., displayed an ingenious model electric railway, upon which a small locomotive operating at 8 volts was running. This little engine was capable of pulling a load of 30 lb. The third-rail system was employed. The suggestion made in connection with this device is that firms' names could appear on the side of the trucks and also that small samples could be loaded into them. Mr. Charles Ledwidge showed a model raised map with boats, propelled by mechanical means, proceeding over "trade routes." Other exhibits were an "Oxford" portable kinema projector (which was demonstrated), several illuminated signs, and an illuminated model of a large factory.

An All-Electric Villa.—On April 8th an all-electric semi-detached villa, one of a series of fourteen now in course of erection, was opened for inspection at Gosforth. The scheme has been carried out under the auspices of the Newcastle-upon-Tyne Electric Supply Co., Ltd., which secured the aid of a number of electrical firms to make the venture a success. Realising the utility of electricity, the builders of the houses agreed to put in lighting and heating circuits during erection, and the Supply Company extended its mains for a short distance to bring the supply to the site. The whole of the interior electrical work has been carried out by Messrs. Robson and Coleman, of Newcastle, and the same firm has supplied all the small electrical apparatus for the houses. The larger apparatus, including an electric cooker (Jackson), a clothes washer ("Universal"), a Western Electric dish-washer, a Watson-Norie water heater and wash boiler, was installed by the Supply Co. It may be of interest to detail the components of the installation, as such a statement will show the completeness of the arrangements. In the hall is a 60-watt gasfilled lamp with inverted bowl, and a 60-watt pendant fitting is on the first landing. In the drawing room there are a "Miller" bowl fitting (200 watt); a floor standard; a "Eureka" vacuum cleaner; and a "Magicoal" fire. The dining room equipment comprises a three-light oxidised-silver fitting; a Jacobean "Angelus" 2-kW fire; a floor standard; "Universal" coffee service, toaster, and kettle; a hotplate; a "Wallace" lamp; a Western Electric sewing machine; a "Genii" immersion heater; and a "Plexsim" vacuum cleaner. The kitchen is illuminated by a "Fullolite" lamp with opal shade, and the equipment consists of a cooker, clothes-washer, and dish-washer; a "Revo" iron; a Jackson two-pint copper kettle; a "Belling" boiling ring; and a hot water circulator and wash boiler. The best bedroom contains a two-light fitting with pink silk shades; a bed light with dimming switch; a 2-kW "Xcel" heater; a milk heater; "Universal" hair curlers and electric iron; and a small brass standard lamp. In the second bedroom is a two-light "Joyner" fitting with silk shades; a bed light; an "Olso" milk warmer; a 2-kW "Cosmos" radiant heater; and an "Electrolux" vacuum cleaner. A small bedroom containe a 100-watt "Equilux" bowl fitting; a "Quead" 1½-kW heater; and an "Electrolux" floor polisher. In the bathroom is a plain pendant, and a G.E.C. pedestal fire. The house remains open for inspection until to-morrow (Saturday).

Indian Electro-Technical Committee.—The *Indian Textile Journal* recently gave particulars of the formation of a National Electro-Technical Committee for India by the Department of Industries. Such a committee was first considered in 1910, but it was decided to postpone its organisation until the manufacture of electrical machinery in India had reached a greater stage of development. The *personnel* of the Committee is as follows:—Mr. A. C. Coubrough, C.B.E. (of Messrs. Mather & Platt, Ltd., Calcutta); Mr. A. Cochran, C.B.E., M.I.C., M.I.N.A., M.I.E. (India), A.M.I.E.S. (of Messrs. Burn & Co., Calcutta); and Mr. C. D. M. Hindley, M.A. (Cantab.), chairman, Port Trust, Calcutta. It is stated, however, that this Committee will only function until the Institution of Engineers (India) is in the position to nominate a permanent and larger committee.

French Agricultural Exhibition.—A practical demonstration of the uses of electricity in agriculture is to be held either at Lille or Douai from May 27th to June 6th, organised by the Office Agricole of the Departement du Nord and the Service de Génie Rural. The show could afford a good opportunity for builders of small motors for farm and household purposes to display their goods. The secretary is M. Charpentier, 2, Rue St. Bernard, Lille.

German Lamp Taxes.—The existing taxes on lamps which were introduced by the law of July, 1909, have been increased, so that the rates are now as follows per lamp:—Carbon-filament lamps, 20 pfennigs up to 15 watts; 40 pf. between 15 and 25 watts; 80 pf. between 25 and 60 watts; 1.20 mark between 60 and 100 watts; 2 marks between 100 and 200 watts; and for lamps of higher consumption 1 mark for each additional 100 watts or portion thereof. Similar graduations also apply to wire lamps, Nernst burners, &c. Arc lamp carbons are subject to a tax of 2.40 marks, and composite carbons to one of 4 marks per kilogramme.

A Swedish Manufacturing Company.—The directors of the New Ruth & Sosséns Elektriska A.B., reporting on the past year's working, state that the results were unsatisfactory, the principal cause of which was to be found in the fall in the prices of manufactures in stock. As the production simultaneously declined it was impossible to avoid the loss which was incurred despite the energetic efforts made to reduce the working expenses. The loss amounts to 4,800,000 kronen, as compared with net profits of 19,000 kr. in 1920. It is proposed partly to cover the loss by the appropriation of the reserve fund of 2,500,000 kr. and the balance brought forward, and to carry the remainder of the debit balance to 1922. The report further states that measures have been adopted in the present year for greatly reducing the working expenses. Good connections have been obtained abroad, but the orders are a long way from corresponding to the company's capacity for delivery, and the existing situation of prices is not profitable. The company was reconstructed in 1920, when the share capital of 16,650,000 kr. was reduced to 8,150,000 kr. on the formation of the new company.

The Institute of Cost and Works Accountants.—The sessional examinations of this Institute will take place on June 19th, 20th, and 21st, and will be held in London, Manchester, Birmingham, Sheffield, Glasgow and Bristol. Application should be made on Form "C," obtainable from the Secretary, 38, Grosvenor Gardens, at least 21 days before the date of examination.

A Belgian Bank and Trade Recovery.—The report of the board of directors of the Banque d'Outremer affirms that the economic depression from which the whole world suffers has apparently reached its lowest level, and that we may hope for an early recovery of trade; it is likely that the progress may be slow, but, in order to prepare for this resumption of business, the company has decided to raise its capital from 72½ millions to 100 millions.

The Foreign Trade of Belgium.—Belgian industries, says *l'Electricite pour Tous*, have scored several noteworthy victories lately and secured important foreign contracts in the face of competition from firms in all countries, and especially Germany. One of these victories was the securing of a contract for rails amounting to 28 millions of levas. Of 49 adjudications in Argentine, Morocco, Brazil, Chile, China, Denmark, Rumania, Finland, Spain, Bulgaria, and South Africa, Belgian concerns obtained 37, or more than three-fourths, and the Germans only eight.

British Manufacturers in Australia.—The eleventh annual general meeting of the Australian Association of British Manufacturers and their Representatives was held at the head office, Collins House, Melbourne, on February 22nd last, and was largely attended. In moving the adoption of the report, the retiring president (Mr. W. C. Guthrie) first referred to the new Australian Customs tariff, which, he stated, was gratifying to British interests, inasmuch as the measure of preference accorded to British over foreign goods had been very considerably extended and increased, and the credit for this satisfactory result was due to the Association. In connection with the Tariff Board which is being set up by the Government, he said that the Association had made strong representations as to the desirability of providing that at least one member of the board should be thoroughly in sympathy with British trade. With regard to reciprocal trade within the Empire, Mr. Guthrie expressed his opinion that the subject was a very difficult one, instancing the possibility of industries situated in Canada and actually American-owned, being placed upon the same footing in the Australian market as competitive industries in Great Britain. He regarded optimistically the prospects for British trade in Australia, pointing out the steady recovery since the war, and expressing the opinion that the extended measure of British preference in the new tariff would materially assist this recovery. Referring to the Geddes Economy Commission, he said that the Association felt that any interference with the Trade Commissioner Service, at any rate in Australia, would be a most unfortunate step, as the Service was undoubtedly proving of great value to British trade. These views had been cabled to the President of the Board of Trade.

Other speakers included Mr. S. W. B. McGregor, H.M. Senior Trade Commissioner, who briefly referred to some of the larger factors which must have an important influence on the development of British trade, such as the Irish Settlement and the Washington Conference. It was not generally known to-day that Australia was Great Britain's second best customer, India coming first. Before the war Australia came fourth, following India, Germany, and the United States. He believed that the question of branch factories in Australia required the careful consideration of British manufacturers. It was a logical and inevitable phase in the development of Australia.

The election of members of the Executive Council resulted in Mr. J. D. Campbell (of Alexander, Ferguson Pty., Ltd.) being chosen president for the present year.

The London office of the Association is at 32, Victoria Street.

Lead.—In their report dated April 22nd Messrs. James Forster & Co. state:—"Values have advanced, the closing prices yesterday being £23 15s. for April and £23 5s. for July, against £22 and £21 12s. 6d. respectively a fortnight since . . . There has been little evidence of demand from consumers, but a fair export trade continues, due probably to short direct shipments from Spain and America not selling at the moment. Consumption in the home trade, we understand, is increasing slowly, and would no doubt be greater if the prices of sheet, pipe, and white lead were on a more reasonable level. Electrical trade demand is very slow, although an improvement should manifest itself before long, owing to the many electrical schemes which are maturing. . . . The market closes strong, with little available lead about for near delivery."

Exhibition of Foreign Samples.—The Department of Overseas Trade has issued a pamphlet describing its Foreign Samples Exhibition, which is now situated in new premises at 7 to 11, Old Bailey, London, E.C.4. It has been organised for the assistance of British manufacturers in their efforts in overseas markets; it contains over 80,000 samples, including some thousands recently received. Manufacturers are invited to visit the exhibition, which is open from 10 to 5 daily and 10 to 1 o'clock on Saturdays.

"Falco" Electric Cookers.—At the Princes Restaurant on April 19th the Countess of Carnworth presented the awards made at the recent Cookery and Food Exhibition. The Falkirk Iron Co., Ltd., received a silver medal, the highest possible award in the commercial class, for its domestic electric cooker. The firm has received an order for electric hot cupboards for the liner, *The Empress of Scotland*, which is being refitted at Portsmouth.

Local Electrical Exhibitions.—An excellent display of all classes of electrical apparatus has been arranged by the Hackney Corporation at the King's Hall Baths. This was opened by the Mayor on April 24th, and a number of well-known electrical firms are represented. The Corporation Electricity Supply Department, for its own part, has contented itself with supplying publicity matter, among which many E.D.A. publications are noticed. Carron Company is exhibiting, among many other appliances, a new 6-kW cooker, in which efficiency and cheapness are combined. A notable feature of this is the extreme ease with which the elements can be got at. The top of the stove hinges backward and the side elements of the oven are provided with pins fitting into sockets. Another new departure of this company is a range of light boiling rings of .75, 1.25, and 1.5-kW loading, the larger sizes arranged for two- or three-heat control. A hot-water circulator is also on view; this should meet with success in Hackney, where heating energy is cheap. The British Thomson-Houston Co., Ltd., confines its attention to lighting. Comparisons are made between several kinds of lighting—carbon lamps, gasfilled and vacuum lamps, natural daylight, and "Trutint" lamps. A case containing many examples of gasfilled lamps is also shown. Berry's Electric, Ltd., has a stand bearing several "Magicoal" fires, and the Hart Accumulator Co., Ltd., exhibits a large collection of accumulator batteries for various purposes. A "Cascade" electric washer and wringer, and an ironing machine are shown by Messrs. Frank Feesey and Co. The Hotpoint Electric Appliance Co., Ltd., displays numerous domestic appliances, including the "Aerobell" washer, a sewing machine, bowl fires, kettles, toasters, vacuum cleaners, &c. The Metropolitan-Vickers Electrical Co., Ltd., also shows a large collection of domestic devices, such as "Cosmos" fires, irons, and kettles, as well as silk shades, candelabra, and floor standards. Messrs. Ransomes, Sims & Jefferies, Ltd., have provided an "Orwell" truck for carrying a load of 4,000 lb.; this is demonstrated. Among the many appliances exhibited by Messrs. Belling & Co. is a "Modernette" cooker, a compact appliance with a total loading of 4,800 watts; a number of fires of various designs, fitted with quick-make and quick-break switches; kettles, boiling rings, urns, &c., and samples of "M.K" connectors, plugs, &c. The Jackson Electric Stove Co., Ltd., in addition to a display of small domestic appliances, exhibits four types of electric cooker, upon which demonstrations are being carried out. Cooking demonstrations are also a feature of the exhibit of the British Electric Transformer Co., Ltd., where a "Tricity" cooker of 3.5-kW loading is shown. This has two boiling rings, a grill being formed by means of a baffle plate placed over one of the rings. Other appliances shown include irons with "universal" voltage and swivelled connectors, kettles, fires, hotplates, toasters, &c. The Sun Electrical Co., Ltd., displays and demonstrates the "A. B. C." electric clothes washer, and the stand also bears numerous other "Sunco" appliances. Messrs. George Nobbs, Ltd., show principally water-heating appliances, many of which have already been described in our pages, such as the "Genii" immersion heater, the "Neptune" hot-water radiator, and sterilisers and distillers. A 7.5-kW cooker is also shown, the chief feature of which is the heat-retaining construction of the door. Railway carriage heaters for working on 1,500-2,000-V circuits are shown. Among low-heat appliances are shown a foot-warmer and a 30-watt bed-warmer. The Falkirk Iron Co., Ltd., prominently displays its "Double-Ray" heaters and toasters, and is also carrying out demonstrations with its electric cookers. A number of fires, kettles, irons, &c., are also shown.

The St. Annes Electricity Department also held an electrical exhibition, from April 6th to 15th, at the Ansdell Institute. A number of local contractors combined to make the show a success. Among these were Mr. A. M. Locke, who made a speciality of the "Stannos" wiring system, and Messrs. Frank Kay & Co., who showed fittings and appliances of all kinds. The Singer Sewing Machine Co., Ltd., demonstrated the application of small motors to their machines. Messrs. Baxendales, of Manchester, exhibited many domestic appliances, including a "Laundry Queen" clothes-washer.

The Five Towns Health and Home Exhibition is being held at Hanley from May 4th to 20th. The Potteries and District Branch of the Electrical Contractors' Association intends to take full advantage of this opportunity for "pushing" electricity, and the following members are participating:—Messrs. Bagguley & Sons; Barnett & Soans; Blackburn, Starling, Ltd.; E. M. Evans & Son; J. W. Potts & Co.; J. Richards & Co.; L. Vaughan; and Woodward, Smith and Co.

The Tokio Exhibition.—*Reuter* says that the British building is certainly one of the most striking in the whole exhibition. There are to be seen some 150 British products, ranging from a large gas engine to specimens of the latest textile designs. The library and reading rooms are well stocked with British catalogues, in charge of the representatives of the Federation of British Industries.

Auction Sales.—Messrs. Shirlaw, Allan & Co., auctioneers, Hamilton, have received instructions from Messrs. James Dunlop & Co., Ltd., owing to termination of leases, to sell by auction on May 4th and 5th, colliery and electric plant at Newton and Hallside Collieries.

Copper and Lead Prices.—Messrs. F. Smith & Co. report April 25th:—Copper (electrolytic) bars, sheets and rods, no change.

Messrs. James & Shakespeare report April 26th:—Copper bars (best selected), sheet and rod, no change; English pig lead, £25 10s., 30s. increase.

Chinese Notes.—The citizens of Nantungchow and Haimen have planned to construct a light railway, 40 li in length, starting from Chen-long, port of Haimen, to Szechangpah, Nantungchow.

A wireless telephonic service was opened between Peking and Tientsin on March 7th. The equipment was supplied by the China Electric Co. and manufactured by the International Western Electric Co. (Inc.), New York. The distance between Peking and Tientsin is 80 miles.

The wires of the long-distance telephone between Shanghai and Nanking will soon be installed.

Before he left China, Dr. J. A. L. Waddell, the American engineer, at the request of the Chinese Government, submitted plans for the construction of a bridge between Nanking and Pukow and for a trolley system connecting Wuchang, Hankow, and Hanyang.

The following companies have been registered by the Ministry of Communications: The Ching Hsing E. L. Co., in Sinti, Hupeh; the Hwan Hsing E. L. Co., Chuhochen, in Kienli; and the Chia Hsi Electric Co.

The Yao Hwang Electric Light Co., in Taihing, Kiangsu, seeks registration with the Ministry of Agriculture and Commerce.

The Soochow Electric Co. has contracted to purchase from a Swedish firm at a cost of Taels 80,000, plant which will arrive in China shortly.

An electric light company has been founded at Yangliutsing in the neighbourhood of Tientsin. The capital is being subscribed.

An "Osram" Window Display.—The General Electric Co., Ltd., has sent us a photograph of a window display arranged by Messrs. Thomas Gunn, Ltd., of Fore Street, to advertise lighting by "Osram" lamps. The arrangement is most effective.

Dublin Electrical Contractors.—At a dinner of the Electrical Section of the Dublin Building Trades Employers' Association, Mr. A. G. Bruty, who presided, referred to the history of the Association and to the necessity that arose for the establishment of an association for electrical contractors when the voltage of the public electricity supply was changed from 100 to 200. This Association afterwards became a section of the larger and more comprehensive body. While the membership a score of years ago numbered but four or five, it now included practically every firm of repute in the electrical industry in the city and suburbs.

A New Method of Packing Wire.—Messrs. W. T. Henley's Telegraph Works Co., Ltd., have decided to break away from the accepted method of packing v.i.r. wires for dispatch, *i.e.*, wrapping them in Hessian tape which takes a considerable time to remove, and which, once removed, is seldom replaced. The new method which this firm is adopting is to pack each coil in a stout fibre-board carton; these are then packed in containers holding three, four, or five cartons. Both cartons and containers are clearly marked with a description of their contents. At present all qualities of wire in sizes of 1/.044 (.0015 sq. in.) and 3/.029 (.002 sq. in.) are being packed in this way, and the method will subsequently be extended to other sizes. The packing of "Henley" tape is being carried out in the same manner.

New Italian Companies.—There has been formed at Florence the Società Elettrica Amiantea for the production, distribution, and utilisation of electrical energy. Capital 400,000 lire in 1,000-lire shares.

The Società Romana per le Ferrovie elettriche del Nord is the title of a company formed at Rome with a capital of 6,000,000 lire, for the construction of railways in Northern Italy.

Construzioni Elettromeccaniche e Termo elettriche is the style of a company formed at Florence, for the manufacture of electrical apparatus. Its capital is 100,000 lire.

A co-operative company, styled the Società per l'Esercizio della Tramvia Milano-Magenta-Costano, has been formed at Milan, with unlimited capital in 25-lire shares, for the working of the above named tramway.

There has been launched at Genoa the Società di Elettricità Liguria Centrale, for the distribution of electricity. Capital, 400,000 lire.

The Società Anonima Ligure Piemontese Impianti Telefonici Moderni has been formed at Genoa, with a capital of 500,000 lire, for the installation of telephone plant.

With its headquarters at Genoa, the Società Distribuzione elettrica a Sesto Monferrato, with a capital of 200,000 lire, has been established to supply electricity to the last-named city.

Studio Elettrotecnico industriale Ingegneri Galenti e Cambiaggi is the style of a company just formed, for the representation of national and foreign firms manufacturing electrical machinery and apparatus. The capital is 50,000 lire, and the offices are at Milan.

At Genoa has been embodied the Società Canali Valle Stura for the carrying out of irrigation and electrical installation undertakings. Capital, 800,000 lire.

Rag. Calvi e Kurscheur is the title of a newly-started company, whose objects are trade in electrotechnical materials. Capital, 100,000 lire; offices 2, Via Cesare Cantu, Milan.

Reconstruction in Europe.—The *Manchester Guardian Commercial* has issued the first of a series of twelve special sections devoted to the supremely important problem of reconstruction in Europe. It is issued at 1s., and contains between twenty and thirty articles on exchange and currency matters as they exist to-day in the various countries of Europe and in the U.S.A. Later sections are to appear between now and October, in which shipping, finances, railways, the reparation problem, banking, labour and other subjects will be specially covered. Mr. Lloyd George, in a "message" to the editor, describes the work as "an expert study of the most urgent question of the day." One of the articles (by Dr. von Glasenapp, vice-president of the Reichsbank) deals with the German balance of indebtedness with the rest of the world, and another, by Fr. Urbig, managing director of the Disconto Gesellschaft, with the practicability of exchange control in Germany.

Excess Profits Duty.—The Para Telephone Co., having made application to the Commissioners of Inland Revenue for an increase of the statutory percentage as regards the business of supplying public telephone service in Brazil, the Board of Referees has ordered that the statutory percentage shall be increased:—

1. In the case of any trade or business carried on or owned by a company or other body corporate, to 7½ per cent.
2. In the case of any other trade or business:—
   (*a*) for accounting periods ending prior to January 1st, 1917, to 7½ per cent., plus 1 per cent.;
   (*b*) for accounting periods ending after December 31st, 1916, to 7½ per cent., plus 2 per cent.; except that for the purposes of sub-section (2) of Section 41 of the principal Act, the statutory percentage shall be 7½ per cent., plus 1 per cent.;

with the addition, in cases 1 and 2 (*b*) for the purposes of sub-section (1) of Section 41 of, and paragraph 4 of Part II. of the Fourth Schedule to, the principal Act, of 3 per cent. for accounting periods ending after December 31st, 1916, and before January 1st, 1920, and of 5 per cent. for accounting periods ending after December 31st, 1919.

The Manufacture of Electrical Apparatus in China.—The United States Commercial Attaché, Julean Arnold, in a report states that the Electrical Appliances Manufacturing Co. has been recently organised and has purchased 75 acres of land in Soochow for the erection of plant. It has made arrangements with the German Siemens Co. in Germany whereby the Chinese company will use the Siemens patents in exchange for a certain percentage of the profits to the German company. Siemens will furnish the Chinese company with a corps of experts to install and assist in the operation of the plant. The company has chosen Soochow, as land is purchased there at less than one-tenth of the price obtaining in Shanghai, and the location is only 80 miles west by water and 55 miles by rail from Shanghai. Furthermore, labour costs are lower at Soochow than at Shanghai. Mr. S. T. Sze, a brother of the Chinese Minister to Washington, is manager of the new company. This concern will manufacture electric motors and all sorts of electrical appliances suitable to the Chinese market. The present capital is given as 1,500,000 Yuan (silver), or about $800,000 gold. They expect to increase this capital as the plant develops.—*Eastern Engineering.*

German Electrical Activity in Japan.—The Berlin correspondent of the *Financial News* reports that Messrs. Siemens Halske and Siemens Schuckert have just signed a large electric contract with the Japanese copper magnate, Furukawa. It is for the erection in Tokio of a big establishment with machinery for the production of electricity. The Japanese and Germans will be jointly interested, and during the next few days 20 of the leading engineers of the Siemens Halske and Siemens Schuckert combination, with a staff of technical experts, will sail for Japan.

British Insulated Works Memorial.—Many hundreds of the employés of British Insulated & Helsby Cables, Ltd., Prescot, witnessed the unveiling of the memorial erected to the employés of the works who fell in the war. Mr. Simpson Hanna, the oldest skilled employé at the works, formally handed over the memorial to Mr. James Taylor, chairman of the board of directors. Mr. Taylor said that on August 4th, 1914, 480 officers and men, fully equipped, left to fight for their country, and at the date of the Armistice there were 1,684 employés of the works at the war.

LIGHTING AND POWER NOTES.

Accrington.—Loan.—Application is to be made for a loan to carry out the extensions of electricity supply to Oswaldtwistle and neighbouring districts.

Barry.—Consultants' Report.—The firm of Sir Charles Bright & Partners has presented to the Urban District Council a report upon the supply of gas and electricity to the town. The report says that Barry is one of the largest towns in the country without an electricity supply of any kind, and it is thought that if the Council does not shortly take steps to secure powers to generate and distribute electricity a private company will do so. Considerable economies could be effected by working an electricity scheme in conjunction

with the municipal gas undertaking; it is, therefore, suggested that generating plant should be installed at the gasworks, where an old retort house of ample dimensions is available. The sets would consist of medium-speed, horizontal gas engines direct coupled to d.c. generators to form a three-wire system. A coke-fired gas producer of 250 h.p. capacity would be installed outside the engine room. It is not anticipated that the supply of electricity would result in any diminution of the demand for gas, but rather that the general standard of illumination would be raised. The consultants do not think there would be a large demand for electricity for power, except at the docks, where electricity is already available.

Birmingham.—Price Reductions.—The Electricity Supply Committee has reduced its charges for energy; the reduction is retrospective to the last meter readings. The reduction amounts generally to a halfpenny per unit in the price for lighting and one-third of a penny for power. The lighting scale now ranges from 6d. per unit, for quantities less than 1,000 units per quarter, to 4d. per unit for a consumption of 20,000 units or more. For power, heating and cooking the rates are as follows: up to 300 units per quarter, 2½d. per unit; 300 units and upwards, 2¼d. per unit. This revision brings the prices back to the 1919 level.

Blackpool.—Loan.—On May 2nd Col. T. C. Ekin will conduct an inquiry on behalf of the Electricity Commissioners into the application of the Corporation for sanction to borrow £220,000 for the purposes of the electricity undertaking.

Cannock Chase.—Electricity Supply.—Mr. C. Jones (electrical engineer to the Cannock Chase Colliery Co.) has reported to the Brownhills Urban Council that the company has decided to proceed with the scheme for supplying the adjoining districts with electricity. The supply, he says, will be carried overhead at 440 V for power and 240 V for lighting. For private purposes the charge will be a maximum of 8d. per unit for lighting, and for public lighting the suggested charge is £3 per lamp per annum for the Brownhills West district and £3 5s. for the other districts, the company to bear the cost of cables and standards.

Ceylon.—Hydro-Electric Scheme.—According to the *Indian Textile Journal* the Government is reported to have now decided to proceed with the Aberdeen-Laxapana hydro-electric scheme in partnership with an engineering firm in England. Of the necessary capital of about Rs. 14,000,000 the Government will contribute three-fifths by raising a special loan in England at an early date; the remainder will have to be invested by the firm undertaking the work.

Cheam.—Street Lighting.—The South Metropolitan Electric Light Co. has agreed to light the parish at a charge of £5 5s. per standard for twelve months.

Continental.—Russia.—The Russian semi-official economic journal reports the formation of a company for the electric lighting and drainage of the city of Kieff, with the co-operation of the Electrical Undertakings Co., of Berlin. The latter will deliver necessary materials to the value of 5,000,000 marks, and will receive interest at the rate of 7 per cent. per annum for any credits granted.

Jugo-Slavia.—The Direction Générale des Eaux, of the Kingdom of the Serbs, Croats and Slovenes, has carried out a survey of the hydraulic power of the new State. As a result of the investigation, it is stated that the power available at low-water amounts to 2,500,000 h.p., and to 7,500,000 h.p. at average water levels. At present only 160,000 h.p. is being utilised, although concessions were granted in 1919 and 1920 for the exploitation of a further 400,000 h.p.

Norway.—For some time past there has been under consideration the question of transmitting electric power from Norway to Denmark. A technical committee was appointed by the Norwegian Government, while the Danish Government also appointed a committee for the purpose of considering the practicability of putting a scheme into operation. The British Legation at Christiania has now forwarded to the Department of Overseas Trade an abstract from the *Tidens Tegn*, of March 22nd, in which it is stated that "the technical committee appointed to consider the project is so far advanced in its work that a meeting is to be held at Christiania on April 18th, when a survey will be drawn up for the information of the Scandinavian Commission appointed to consider the question of power transmission to Denmark. No information has yet become available, but it is rumoured that the committee will report favourably upon a scheme to transmit the power along the West Coast of Sweden."

France.—An intercommunal syndicate has been formed at Epinal to draft a scheme for the electrification of a group of communes in the Department of the Vosges.

Five communes in the Department of Dordogne have formed themselves into a syndicate, and have applied for a concession to build a hydro-electric station at an existing dam on the Isle river in order to supply electricity for agricultural, lighting, and power purposes.

Czecho-Slovakia.—According to Czecho-Slovakian Ministerial utterances, a company is shortly to be formed, styled the Vereinigten Elektricitätswerke A.G., in Prague, to carry out the following programme: The setting up and working of (1) a generating station at the State coal mine at Hedwig, near Erweniz, with a capacity of 45,000 kW, a transmission line to Prague (100 km.), at a pressure of 100,000 V, with the chief transformer stations at Prague and Kladno. The electrical energy will be stepped down to 22,000 V, with feeder conductors for the connections in the neighbourhood, the estimated cost being 300,000,000 kr.; (2) a hydro-electric generating station at Stechowitz with a fall of 70 metres and a capacity of 75,000 kW, yielding yearly 350,000,000 kWh, with a cable 50 km. in length to Prague, the cost being 450,000,000 kr.; (3) a low-pressure hydro-electric station at Vrany, with a fall of 10 metres, capacity 10,000 kW, yearly yield 41,000,000 kWh, with a line connecting with the Stechowitz electric works, the cost being 80,000,000 kr. The Erwenitz station is to be completed within two years, that at Stechowitz within five, and the Vranya station in 1927.—*Elektrische Kraftbetriebe und Bahnen.*

An agreement has been arranged between German-Austria and Czecho-Slovakia with regard to the utilisation of the water power of the Thaya river. By the agreement Czecho-Slovakia is to erect a frontier hydro-electric works between Zaisa and Baumol, utilising such portions of the land on the Austrian side of the river as may be needed for the river constructions. Czecho-Slovakia has agreed to supply 6,000,000 kW. Construction must begin within five years after the conclusion of this agreement.

A conference recently took place at Pressburg to arrange the formation of an electricity supply company to serve West Slovakia. It was agreed to start the company with a capital of 8,000,000 kr., which was to be doubled in three years. Contributories to the scheme are the State, the county of Pressburg, and the surrounding towns and communes. The object of the company is the carrying out of a systematic electrification of the Pressburger Komitat.

The Central Moravian Electrical Co. is increasing its capital from 2,000,000 to 3,000,000 crowns. Its headquarters and works are at Prerov, and it is intended to utilise the water-power near Kromeriz.

Cookham.—Special Order.—The Electricity Commissioners have submitted to the Ministry of Transport for confirmation a Special Order granted to Lord Meston and others for the supply of electricity within part of the parish of Cookham.

Dartford.—Proposed Extensions.—The Urban District Council is approaching the Erith Council to ascertain whether it would be prepared to negotiate for the transfer of a generating set of 200-kW capacity. Provided satisfactory arrangements are arrived at it is proposed to send a deputation, representing the Erith, Dartford and Woolwich Councils, to wait upon the Electricity Commissioners with a view to obtaining their consent to plant extensions.

Dundee.—Bulk Supply Rejected.—The Town Council has rejected the proposed agreement between the Corporation and the Grampian Hydro-Electric Development Co., Ltd., as the terms offered are not sufficiently favourable to the city.

Glasgow.—Electric Cooking.—The Corporation Electricity Department has lately experienced a good demand on the part of householders for electric cookers. About 200 of these appliances have been installed recently, and last week the Electricity Department authorised the purchase of another 200, there being a long list of applications for cooking appliances. The cookers are hired out at an annual rental of £2.

India.—Bengal.—A Committee has been appointed by the Government of Bengal to consider the question of the Hydro-Electric Survey of the Presidency.—*Reuter's Trade Service* (Bombay).

Calcutta.—It is anticipated that work on the extensions of the Cossipore power station will be complete in four years. The extensions, when completed, will nearly double the present output, which is 21,500 kW. The cost of the new plant is estimated at £665,665.

Surat.—The report of the Surat Electricity Co. for the year ended December 31st last shows that the laying of mains is now well advanced. The power station, offices, &c., have been completed, and the erection of generating sets, each comprising one 150-b.h.p. Mirrlees-Diesel engine, with a Crompton alternator, complete with accessories, and the work of laying the underground mains and constructing an aerial distribution system, are also well in hand. An agreement has been entered into with the Anglo-Persian Oil Co., Ltd., for the supply of liquid fuel for a period of ten years, and it is hoped that the company will be in a position to commence the supply of electricity to the district at an early date.

Langholm.—Proposed Water-power Scheme.—The Town Council is having a survey made by an engineer as to the possibilities of generating electricity by water power.

London.—St. Pancras.—The Borough Council has received sanction from the Electricity Commissioners to the borrowing of £3,355 for ash-handling plant at King's Road station.

Manchester.—Reduced Charges.—The Electricity Committee has decided to recommend to the City Council a slight reduction as from the June quarter in the charges for elec-

tricity. It was reported that during the past year there had been a net profit of £43,229 after providing for all capital charges and income tax. This sum is to be placed to the reserve account.

Rochdale.—Disposal of Profit.—On the past year's working of the electricity undertaking there is a surplus of £22,649. It is proposed to allocate £7,000 towards the relief of the rates and, in view of the heavy contemplated expenditure during the coming year, to carry forward the balance to reserve.

St. Mellons.—Special Order.—The Electricity Commissioners have granted a Special Order to the South Wales E.P.D. Company giving it powers to supply electricity within the rural district. Details of the area are given in three schedules. A fourth schedule fixes the maximum price per unit at 9d.

Shoreham-by-Sea.—Special Order.—Mr. Frank Gibbs, of Beach Shipyard, has been granted a Special Order enabling him to supply electricity to Shoreham and Lancing. The maximum price per unit he will be permitted to charge is 1s.

Stafford.—Loan Sanctioned.—The Electricity Commissioners have sanctioned the borrowing by the Town Council of £4,710 for the laying of a cable to the English Electric Co.'s works.

Stroud.—Electricity Supply.—The Rural District Council has decided not to oppose the scheme proposed by the Norchard Electric Power Co. for supplying the district with electricity.

Ventnor.—Street Lighting.—The Urban Council has accepted the offer of the Isle of Wight Electric Light Co. for street lighting for three years for a quarterly payment of £68 15s., plus 6d. per unit for electricity consumed.

Walmer.—Scheme Abandoned.—The secretary of the Gas Co. has informed the Urban Council that the company has definitely decided not to carry out the electric lighting scheme owing to altered circumstances since the war.

TRAMWAY AND RAILWAY NOTES.

Continental.—Italy.—A company has been formed, styled Società fur la Ferrovia Adriatico-Sangritana, to carry out the electrification of the railway from the Adriatic to Sangritana. The cost of the undertaking is estimated at 18,000,000 lire, exclusive of rolling stock, and the line is to be complete and ready for working by the end of December, 1923.

Dover.—Extension of Time.—The Ministry of Transport has granted a further extension of time to July 9th, 1922, for constructing the St. Margaret's and Martin Mill light railway.

Edinburgh.—Proposed Extensions.—The Corporation intends applying for a Provisional Order granting powers for tramway extensions which are expected to take seven years to complete. The estimated cost of the extensions is as follows: in connection with the electric tramways, £105,144; for the adaptation and conversion to electric traction of the remaining sections of the Corporation tramways, £110,644; and for tramway equipment, cars, rolling stock and depôts, £314,367.

Jugo-Slavia.—Railway Construction.—*The Times* Belgrade correspondent states that a Special Committee of Ministers is considering the offer of an American group to construct a number of broad-gauge railways. The lines would include a route from Kladovo, *via* Belgrade, Valjevo, and Sopotniko, to the Adriatic. The syndicate is to have the right to carry out the electrification of any lines it constructs, and it offers the Government $10,000,000 for the concession.

Manchester.—Reduced Fares.—The Tramways Committee has decided to recommend the City Council to reduce the tramway fares. The Committee has also decided to hand over £50,000 to the relief of the rates.

Mexico.—Railway Electrification.—The President of the Republic has inaugurated the work of electrification of the Santiago-Valparaiso line and ramifications, a length of 350 km.—*Reuter's Trade Service* (Santiago).

Sunderland.—Strike Settled.—The strike of the employés of the Sunderland District Tramway Co., which has lasted for three months, was settled last Friday night.

TELEGRAPH AND TELEPHONE NOTES.

Denmark.—Telegraph Agreement.—The Danish Store Nordiske Telegraf Selskab has applied to the Swedish Government for a renewal of the agreement between the two parties, which will expire in about three years from the present time, having been prolonged in 1910 for a period of 15 years. An agreement also exists between the Government of Finland and the Great Northern Telegraph Co. with regard to the telegraphic traffic to the west, and if Sweden were to terminate the contract with the Danish company this would influence the relations between the latter and Finland, because the company would no longer be able to fulfil its contract obligations. Finland and Sweden would then have to arrange their own mutual telegraphic connections. As a consequence the attitude of the Swedish Government is also of exceptional interest for Finland. Sweden receives a considerable amount in transit taxes, which will be increased when the company's services to Russia and the Far East are resumed. In some circles in Sweden it is desired to become independent of a Danish company, and in this respect there is the example of Norway. But the position of Sweden and Norway in relation to the company is quite different. In Norway the company only owns the cables between Norway and England, but no transit traffic proceeds through Norway. For the rest the separation of Norway from the company would be very dear to the former.—*Financial Times.*

Russia.—Telegraphic Communication.—Direct telegraphic communication between Germany and Russia has been established *via* Dvinsk.

Telegraphing to India.—The Council of People's Commissaries has granted a concession for telegraphic communication between India and Europe. Communication will be through Russian territory, and there will be connection with Turkey, Egypt, Persia, and the Mediterranean countries, says the *Daily Telegraph.*

Spain.—Wireless News Service.—Spain is following the example of other countries and organising a wireless news service. A central station is to be established at Madrid, whence, at certain hours in the day, messages will be dispatched to posts in the provinces within a radius of 600 km. The station will also be equipped to communicate with the western coast, distant 700 km. from Madrid, and with the Balearic Islands. The length of wave adopted is 1,800 metres. Facilities are to be provided for the transmission and reception of news from foreign stations.

Tristan da Cunha.—Wireless Communication.—The island will no longer be known as the loneliest in the world, as the citizens of Cape Town, S.A., have presented the islanders with a wireless outfit having a range of from 1,000 to 1,500 miles.—*The Times.*

Wireless Telegraphy.—Imperial Chain.—The Anglo-Egyptian wireless service *via* the Imperial Wireless stations near Oxford and Cairo commenced on April 24th. Telegrams will be accepted at any post office for Egypt, Palestine, and Syria for transmission by wireless, and a corresponding service will be available in the opposite direction. The rates of charge will be 3d. a word less than the corresponding cable rates for full-rate traffic and 1½d. a word less than the corresponding cable rates for deferred traffic.—*Westminster Gazette.*

Fishing Boat Installations.—During the last ten years wireless apparatus has been installed in some 200 French fishing vessels. Wireless is now regarded as an indispensable part of the equipment of a modern trawler. By its use information can be collected and distributed as to the best fishing grounds and the best time and place for disposing of the catch. The owner can exercise control over the movements of the vessel, and expedite or delay its return to port as desired. The French postal authorities telephone the messages direct from the coast wireless station to the owners. The range of fishing vessels is generally sufficient to allow a trawler to communicate directly with the shore stations.—*The Times.*

Wireless Telephony.—International Conference.—The International Radio Conference, which met in Paris for five days last week, as noted in our last issue, adjourned for a week on April 19th, and met again in London on the 24th inst. The Conference, an American idea, is attempting to induce the large radio powers of the world to co-operate in the building of plant in South America. If the plan fails it will mean duplication. The two adjournments, from Cannes to Paris, and from Paris to London, would seem to show that all has not been working smoothly. Germany is represented by delegates from the Telefunken Co., Great Britain by the British Marconi Co., France by the Radio France, and America by the Radio Corporation.—*Birmingham Post.*

Broadcasting.—In view of the broadcasting wireless telephone service, which Mr. Godfrey Isaacs announced last week the Marconi Co. is ready to organise, considerable interest attaches to the forthcoming statement promised by the Postmaster-General on the Government attitude regarding the use of wireless in cases where it is likely to prove of value to trade and industry. At the present time the number of licences held by amateurs in this country for receiving sets is between 6,000 and 7,000, and for transmitting apparatus 286. The annual revenue derived from the fees is, according to *The Times*, £3,265 and £355 respectively, and the annual expenditure in connection with the issue of licences and the inspection of stations is about £5,000.

Permission to use receiving apparatus is granted with comparative freedom by the Post Office: but while there is a tendency in some quarters to press for the removal of any restrictions on facilities for transmission, the United States Government is considering the restriction of the use of wireless telephony for purposes other than Government and commercial

communications. Though there are fewer than 300 persons holding transmitting licences in England their activities sometimes interfere with official and commercial communications. It is not uncommon for Croydon Aerodrome to issue a general request to amateur transmitters to "stand by" for varying periods. A receiving installation, too, when amplifying valves are used, can occasionally cause disturbance, as the action of the valves sometimes puts a certain amount of energy into the aerials. For this reason the use of amplifying valves is not permitted to amateurs experimenting within two miles of a large official or commercial station.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Argentina.—Buenos Aires.—June 28th. Municipal Council. Plant for hydro-electric generating station and transformer sub-station.*

Australia.—Melbourne.—September 1st. Victorian Electricity Commissioners. Five surface feed-water heaters, six surface vapour condensers, and 12 feed-water evaporators.

July 5th. Victorian Railways. One 2-ton storage battery truck with jib crane and lifting magnet. Three passenger electric elevators and one freight elevator with all equipment.

Blackhall Colliery.—Electric light fittings for Comrades' Club. Apply No. 18, 11th Street, Blackhall Colliery, Durham.

Doncaster.—May 8th. Electricity Department. Two water-tube boilers, with economisers, induced draught plant, and steel chimney. (April 21st.)

Edinburgh.—May 15th. Electricity Department. Six or 12 months' supply of electricity meters. (See this issue.)

Egypt.—Alexandria.—June 1st. Ports and Lights Administration, The Arsenal. Six months' supply of general stores, including electrical gear, &c.

Fleetwood.—May 9th. Electricity Department. One 1,000-kW d.c. turbo set, with switchgear and condenser. (See this issue.)

Glasgow.—May 1st. Lighting Department. Supply of electrical fittings and accessories for 12 months. Specifications from the Lighting Department, 20, Trongate.

Grand Duchy of Luxemburg.—May 8th. Administration Syndicate at Koerich, Luxemburg. Supply of five three-phase electric motors and centrifugal pumps, ranging from 7½ to 25 h.p.; also five kilometres of underground electric cable, and five kilometres of underground telephone cable in connection with the water supply undertakings in the Esch and Capelien Cantons.

London.—H.M. Office of Works.—May 4th. Engineering labour (electrical, &c.) required in the Newcastle-on-Tyne and Southampton districts during a period of three years. Secretary, H.M. Office of Works (Contracts Branch), King Charles Street, London, S.W.1.

Manchester.—May 9th. Tramways Committee. Trucks for tramcars. Mr. J. M. McElroy, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

Middleton.—May 1st. Electric installation at Providence Congregational Church. Specification from Mr. S. Pauls, borough electrical engineer, Middleton.

Morocco.—Rabat.—May 27th. Postal Department. Supply of bronze and copper wire, in two lots, deliverable by October 1st, also porcelain insulators, in two lots, for the postal service. Particulars from the Office des Postes, Télégraphes, et Téléphones, at Rabat, Morocco.

Mountain Ash.—May 8th. Urban District Council. E.h.p. overhead and underground transmission mains. (See this issue.)

New Zealand.—Auckland.—June 1st. Tramways Department. Electric equipment for ten bogie tramcars.

Wellington.—July 8th. Public Works Department. Eight steel transmission line towers.

Preston.—May 30th. Electricity Department. Two 10,000/12,000-kW turbo-generator sets, with condensing plant, auxiliaries, and piping; house-service plant, comprising one 1,200-kW turbo-generator and two a.c. 6,600/220-V d.c. sets. (See this issue.)

Siam.—Bangkok.—June 28th. Department of Posts and Telegraphs. Telegraph and telephone materials, about £10,000. Chief electrical engineer, Telephone Exchange, Bangkok.

*A copy of the plan, specifications, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Egypt.—A £70,000 contract for the supply and installation of pumping machinery at Atf, in Lower Egypt, has been secured by a British concern. There was keen competition on the part of Swiss, German, French, Dutch, and other firms, but the contract was awarded to the Associated British Manufacturers, who are the agents for the English Electric, Paterson Engineering, and Glenfield and Kennedy companies.—*Reuter's Trade Service* (Cairo).

France.—French Post and Telegraph authorities at Algiers have just placed a contract for the supply of 60 tons of copper wire with the Société des Trefileries et Laminoirs du Havre, of Le Havre.

Government Contracts.—The following Government contracts were placed during March, 1922:—

Admiralty Contract and Purchase Department.

Automatic telephone exchange equipment.—Relay Automatic Telephone Co., Ltd.
Batteries and cells.—Premier Accumulator Co. (1921), Ltd.; Chloride Electrical Storage Co., Ltd.; D.P. Battery Co., Ltd.
40-amp.-hr. cells.—Fuller's United Electric Works, Ltd.
Storage battery cells.—Chloride Electrical Storage Co., Ltd.
Containers and covers for electrical storage battery.—Fuller's United Electrical Works, Ltd.
Electrodes.—Quasi-Arc Co., Ltd.
Mica.—Micanite and Insulators, Ltd.; Mica Manufacturing Co., Ltd.
Switchboard with instruments, &c.—Park Royal Engineering Works, Ltd.
Switches.—Fuller's United Electric Works, Ltd.
Tubes, conduit, and fittings.—Brotherton Ediswan Tubes & Conduits.
Electric trolleys.—British Electric Vehicles, Ltd.

Air Ministry.

Electro-cardiograph apparatus.—Cambridge & Paul Instrument Co.
Modifications to transmitters.—C. F. Elwell, Ltd.

Post Office.

Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; Phœnix Telephone & Electrical Works, Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Testing, protective apparatus, &c.—Automatic Telephone Manufacturing Co., Ltd.; Evershed & Vignoles, Ltd.
Wireless apparatus.—C. F. Elwell, Ltd.
Telegraph and telephone cable.—Connollys (Blackley), Ltd.; Enfield Ediswan Cable Works, Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Pirelli-General Cable Works, Ltd.; Siemens Bros. & Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Leclanché porous cells.—General Electric Co., Ltd.; Siemens Bros. & Co., Ltd.
Loading coils.—Western Electric Co., Ltd.
Condensers.—Dubilier Condenser Co. (1921), Ltd.; Fuller's United Electric Works, Ltd.
Cords for telephones.—Macintosh Cable Co., Ltd.
Ducts.—Doulton & Co., Ltd.
Lead sheet and strip.—T. & W. Farmiloe, Ltd.
Insulated staples.—Tower Manufacturing Co., Ltd.
Creosoted troughing wood.—Burt, Boulton & Haywood, Ltd.; Calder and McDougall, Ltd.
Copper wire.—Enfield Ediswan Cable Works, Ltd.
Laying conduits.—Many contracts for laying conduits in London and the provinces have been placed during the month.
Manufacture, supply, drawing-in and jointing cable.—Newcastle, Durham, West Hartlepool: W. T. Henley's Telegraph Works Co., Ltd.; Brighton, Worthing, Ipswich-Aldeburgh: Johnson & Phillips, Ltd.
Repairing battery, Birmingham Central Telephone Exchange.—Alton Battery Co., Ltd.
Telephone exchange equipment.—Windsor: Automatic Telephone Manufacturing Co., Ltd.; sub-contractors for batteries: D. P. Battery Co., Ltd.; for charging machines: Crompton & Co.; stock for various automatic exchanges in contemplation: Automatic Telephone Manufacturing Co., Ltd.; Warrington: Siemens Bros. & Co.; sub-contractors for batteries: Tudor Accumulator Co., Ltd.; for charging machine: English Electric Co., Ltd.; Rock Ferry: Siemens Bros. and Co., Ltd.; sub-contractors for batteries: D. P. Battery Co., Ltd.; for charging machine: English Electric Co., Ltd.
Transmitter (Seaforth, Liverpool, Wireless Station).—Radio Communication Co., Ltd.

Crown Agents for the Colonies.

Cable.—British Insulated & Helsby Cables, Ltd.; Western Electric Co., Ltd.; Hooper's Telegraph & I. R. Works, Ltd.
Copper wire, &c.—T. Bolton & Sons, Ltd.
Sounders, &c.—Automatic Telephone Manufacturing Co., Ltd.
Spares for Diesel engines.—English Electric Co., Ltd.
Switchgear.—Metropolitan-Vickers Electrical Export Co., Ltd.
Telegraph line material, &c.—Siemens Bros. & Co., Ltd.
Telephone apparatus.—British L. M. Ericsson Manufacturing Co., Ltd.
Wireless station.—Marconi's Wireless Telegraph Co., Ltd.

Commissioners of Public Works, Dublin.

Electrical work and supplies (Dublin district).—Handley & Robinson, Ltd.

Keighley.—Tramway Committee. Accepted:—

Two motor-omnibuses (at present on hire) (£1,575 each).—Leyland Motors, Ltd.

Leyton.—The Urban District Council has recently set its seal to the following contracts:—

Motor converters and armour-clad switchgear.—Bruce Peebles & Co., Ltd.; and Reyrolle & Co., Ltd.
Extra h.p. cable—W. T. Henley's Telegraph Works Co., Ltd.
Tramway feeder cable.—Union Cable Co., Ltd.
Transformers.—Hackbridge Electric Construction Co., Ltd.
Overhead crane.—Vaughan Crane Co., Ltd.

London.—Hammersmith.—Electricity Committee. Recommended:—

Supporting steelwork in connection with the two additional boilers (£376).—Redpath, Brown & Co., Ltd.
20-ton weighbridge, 20 ft. x 8 ft. (£450).—Whessoe Foundry and Engineering Co., Ltd.

The Committee has agreed to the payment of an additional £925 on the contract of the Stirling Boiler Co. of £5,160, accepted in 1918, for boiler, superheater, and fittings, due to the advances in the prices of materials, increases in wages, and reduction of working hours.

FORTHCOMING EVENTS.

Society of Engineers.—Monday, May 1st. At Burlington House, Piccadilly, W. At 5.30 p.m. Paper on "The Testing of Small Electrical Plant," (Part II), by Dr. C. V. Drysdale.

Institution of Electrical Engineers (Western Centre).—Monday, May 1st. At the South Wales Institute of Engineers, Park Place, Cardiff. Paper on "Electric Motor Starters," by Mr. J. Anderson.

(Wireless Section).—Wednesday, May 3rd. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "Short Wave Directional Experiments," by Mr. C. S. Franklin.

Electricity Supply Commercial Association (Greater London Division).—Tuesday, May 2nd. At Stratford Church Institute, 27, Romford Road, E. At 7.30 p.m. Address by Mr. G. R. Smith, general secretary.

Institution of Civil Engineers.—Tuesday, May 2nd. At the Institution, Great George Street, S.W. At 6 p.m. James Forrest lecture, "Some Post-War Problems of Transport," by Sir J. A. F. Aspinall.

Roentgen Society.—Tuesday, May 2nd. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Ordinary meeting.

Institute of Metals.—Wednesday, May 3rd. At the Institution of Mechanical Engineers, Storey's Gate, S.W. At 8 p.m. Annual May Lecture by Prof. Sir E. Rutherford, F.R.S., on "The Relation of the Elements."

Iron and Steel Institute.—Thursday and Friday, May 4th and 5th. At the Institution of Civil Engineers, Great George Street, S.W. At 10.30 a.m. Annual general meeting.

May 4th. At the Connaught Rooms. At 7 p.m. Annual dinner.

Chemical Society.—Thursday, May 4th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary meeting.

Junior Institution of Engineers.—Friday, May 5th. At Caxton Hall, S.W. At 8 p.m. Lecturette, "Gold Castings under Steam Pressure," by Mr. E. H. Ching.

Edinburgh Electrical Society.—Friday, May 5th. At the Philosophical Institute. At 8 p.m. Annual meeting.

Royal Society of Arts.—Friday, May 5th. At John Street, Adelphi, W.C. At 4.30 p.m. Joint meeting with the Dominions and Colonies and Indian Sections. Lecture on "Imperial Wireless Communication," by Prof. W. H. Eccles, F.R.S.

Association of Engineers-in-Charge.—Saturday, May 6th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Informal discussion on "Uniflow v. Multiple Expansion Steam Engines."

London Association of Foremen-Engineers.—Saturday, May 6th. At Cannon Street Hotel. At 6 p.m. Sixty-ninth anniversary festival.

Electrical Power Engineers' Association (Kent Section).—Saturday, May 6th. At Slessati's Restaurant, Rendezvous Street, Folkestone. At 3 p.m. General meeting.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

To enable us to complete replies to queries received this week we need the names of suppliers or manufacturers of :—

An electrically-operated bolt whereby a front or other door can be opened from the top of a house (said to be in common use in American apartment houses).

An adhesive tape wound on a cardboard bobbin which has a blue line running through its centre.

NOTES.

Fatality.—Through an explosion due, it is believed, to fusing of an electric cable of a coal-cutting machine, in View Park Colliery, Uddingston, Lanarkshire, eleven men were injured and two have since died.

The Jubilee Celebration of the Institution of Electrical Engineers.—As previously intimated, if a sufficient number of applications are received we shall be able to supply sets of the 13 portraits of electrical pioneers, which we printed in connection with the I.E.E. Jubilee. A fair number of inquiries have been sent to us, but not yet enough to cover the cost; the offer will remain open for another fortnight.

"Luciferin" Chemical Light.—The production of cold, artificial light by chemical means has been achieved after eight years' experimenting by Prof. Newton Harvey, of Princeton University, U.S.A. The basis of the discovery is a substance which Prof. Harvey calls "luciferin." It is extracted from minute shell-fish. In essentials, it is stated, it is the same as that by which glow-worms produce illumination and which causes certain forms of decaying organic matter to glow. Isolated from insect or other organism, however, the substance soon loses its light-giving power, and Prof. Harvey was obliged to seek a method of perpetuating it. It was found that "luciferin" regained vitality in contact with oxygen, but prolonged contact had the effect of again destroying the light-giving power. Prof. Harvey and his assistants therefore turned their attention to finding a catalytic agent which would produce the desired intermittent reaction between "luciferin" and oxygen. The nature of this reagent remains his secret. For practical purposes the light-producing composition is dissolved in water. In a dark room a flask full of the liquid presents the appearance of water burning with a dark blue flame. At a distance of 4 ft., says Prof. Harvey, it is possible to read a newspaper. At the present stage of development he admits that the light has no practical use, "but like other work in pure science, no one can predict what the practical results will be."—*Daily Mail.*

Appointments Vacant.—Electrical engineer and tramways manager (£500), for the Bexley U.D.C.; chief assistant electrical engineer (£725) for the Bradford Corporation Electricity Department. (See our advertisement pages to-day.)

Educational.—Engineering in the Post Office.—Sir William Noble, engineer-in-chief of the Post Office, calls attention in *The Times* to the opportunities which the engineering branch of the Post Office offers and to the competitive examinations which are being re-introduced for assistant engineerships. The first of these examinations is now taking place. They are open to :—

(*a*) University graduates holding engineering degrees.
(*b*) Whitworth scholars.
(*c*) Students of the Imperial College of Science and Technology who have gained the Diploma of Membership of the Imperial College in physics or engineering, or who hold the Diploma of Associateship of the City and Guilds Institute.
(*d*) Post Office employés nominated by the Engineer-in-Chief.

The age limits are from 20/23 years, with the proviso that in the case of examinations held within two years of the date of the first examination the upper limit shall be 25 years. In the case of post-graduates who have acquired practical experience in approved engineering works an extension of age based on the length of this experience, but not exceeding two years, may be granted. Further, an ex-Service candidate may be allowed to deduct from his age any time up to a maximum of two years which he has spent in the Forces. Successful candidates will be required to serve a probationary period of two years.

Of more interest from the point of view of careers for boys is the open competition which is being instituted for the junior grade of inspector in the Engineering Department. The age limits in this case are from 17 to 20, with a similar proviso that in the case of the examinations held within the next two years the upper limit shall be 22. In this case also ex-Service candidates may deduct from their ages any time up to a maximum of two years. A "pass" standard must be reached in the following subjects :—

(1) Pure mathematics; (2) applied mathematics; (3) heat, electricity, and magnetism; (4) engineering, drawing and design, and in either (5) sound and optics; or (6) chemistry; and also in (7) personal qualities.

Successful candidates are required to serve a probationary period of two years. These examinations will take place once or twice a year as the need arises.

Technical Training in India.—It is understood that the Government of the United Provinces is considering the question of erecting a large modern institution for the training of mechanical and electrical engineers. The college will be located at Lucknow near the O. & R. Railway locomotive workshops.—*Reuter's Trade Service* (Bombay).

Faraday House Entrance Scholarships.—As a result of the entrance scholarship examination, held at Faraday House this month, the following awards have been made :—

R. W. Griffin, County School, Beckenham, the "Faraday" scholarship of fifty guineas per annum, tenable for two years in college and one year in works.
D. Moody, Central Foundation Boys' School, London, the "Maxwell" scholarship of fifty guineas per annum, tenable for one year in college and one year in works.
W. Swindells, Municipal Secondary School, Brighton, an exhibition of thirty guineas per annum, tenable for two years.
B. K. Watts, Aldenham School, an exhibition of thirty guineas per annum, tenable for two years.
J. W. Bailey, Elizabeth College, Guernsey, an entrance prize of twenty guineas.
D. F. Gover, Dulwich College, an entrance prize of twenty guineas.

Service Notes.—Recruiting for the electrical branches of the service is not at all brisk at the moment. Ex-soldiers are being permitted to rejoin under certain conditions. Commissioned Telegraphist G. H. Carkeet has been posted to the battleship *Iron Duke*. Additional officers of the electrical units formed during the war period have been posted to the Territorial Reserve of Officers.

Rural and Urban Dwellings.—The United States Bureau of Census reports that in 1920 there were 20,697,204 dwellings in the United States. Of these 54.1 per cent. are rural dwellings; consequently there is a vast market for the electrical industry, which as yet has hardly been scratched, and the rural customers' demand will probably equal, if it does not surpass, that of the urban consumers.—*Electrical World.*

Scientific Congress in Belgium.—The General Secretary of the Association des Ingénieurs sortis de l'Ecole de Liége informs us that the Congress with which the 75th anniversary of the foundation of the Association will be celebrated has been postponed one week, and will open on June 18th, instead of June 11th, 1922. Particulars of the Congress were given in our issue of March 10th, 1922, p. 343.

Provision of Power for Wireless Telegraphy.—The paper that was read by Capt. J. H. Whittaker-Swinton, A.M.I.E.E., before the Wireless Section of the Institution of Electrical Engineers on the above subject, had for its main objects the survey of the various forms of power at high pressure which have been used in connection with continuous-wave wireless telegraphy since the early stages of the development of that system; an examination of present practice in experimental working in connection with transmitting sets of small power; and a statement as to probabilities regarding the future.

The essential requirements for producing "pure continuous waves" are set out and a description is given of successful methods, and of others.

The conclusion reached is that direct (*i.e.*, unidirectional) current directly generated is inherently the best form of power, and that British engineers have now quite sufficient experience and data to design and construct generating machinery for large outputs at the high pressure required for world communication.

It is hoped that means may be found of carrying on the research work with alternating current, but at the moment the author considers that high-pressure direct-current still holds the field, and for large-power sets it should certainly be possible to construct thoroughly sound direct-current generators to give 10,000 volts and, say, from 20 to 30 amperes from one commutator. Such machines are, of course, quite special, and would be of the nature of special engine-driven generators or motor-generators, which arrangement would be very satisfactory, as by variation of field strength the transmitters could be more readily and safely tuned up to full power. The author has reason to believe, however, that six-phase or twelve-phase transmission could be successfully arranged, using three-phase 50-period energy from public supply mains as the prime mover. Twelve-phase or, rather, twelve-half-wave continuous waves could be practically as pure as direct-current-generated continuous waves, but for equal harmonics it is thought that they cannot be so efficient.

The subject is so large that no apology is made for not having written for the expert, as a more general paper appeared to be needed for the average member, and to give general information to engineers and wireless enthusiasts.

A Fire-damp Detector.—An invention by two London scientific engineers designed to make the detection of fire-damp certain is undergoing tests at the Home Office. It comprises a small attachment for use with the present electric hand lamp which enables the user to note the actual amount of fire-damp, which can be easily read from a scale.—*Daily Dispatch.*

According to the *Daily Telegraph* the device is the work of Messrs. Alfred and Leo Williams, of Chiswick. Firedamp is found in most of the coal mines of the United Kingdom. One of the advantages of the "methanometer" is that it will increase the proportion of the electric lamps employed, thereby providing an illuminant which will at once be more perfect in itself and less injurious to the eyesight. Messrs. Williams's invention will enable the workman to ascertain the actual amount of firedamp surrounding him, and, by adjusting the ventilation, reduce the quantity down to safe limits. The attachment is exceedingly small, and will fit snugly over the globe of the safety lamp. The inventors have a second string to their bow—an automatic contrivance which eliminates the personal element altogether. It is set before the miner descends the shaft, and raises an alarm by flashing a light or sounding a bell the moment dangerous firedamp asserts its presence. This device was brought to the notice of the Home Office two years ago, and is now passing the last tests.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Liverpool Sub-Centre. Mr. J. W. Beauchamp read his paper on "Engineering Advertising and the Work of the E.D.A.," before the Sub-Centre, on April 24th. The following members took part in the discussion:—

Messrs. Dickinson, Clothier, Hansom, Collie, Holttum, Collin and Nisbett.

Edinburgh Electrical Society.—On April 22nd, members of the Society visited the recently constructed hydro-electric generating station which supplies the Tweed Mills, at Walkerburn, owned by Messrs. H. Ballantyne & Sons, Ltd. Mr. Ewan conducted the party over the works, and the Society was much interested in the unique arrangements for pumping water to a hill reservoir during idle hours and utilising this stored power for the day working of the mills, which we described recently. The Society had tea and held an informal concert in the Walkerburn Hotel.

Institute of Transport.—The Institute is to hold an international congress at the Institution of Civil Engineers, from May 17th to 20th. Sir Henry Maybury is to open the proceedings and many eminent foreign and colonial experts will be present. Among the papers to be presented are several upon the design of mechanical vehicles and the financial aspect of passenger and goods traffic. Capt. H. Riall Sankey is to read a paper on "Wireless as an Aid to Transport." A reception will be held on May 16th, at the Hôtel Métropole; the Lord Mayor will give a *conversazione* on May 17th; and on May 18th, the Institute's third annual dinner will be given.

Incorporated Municipal Electrical Association.—The annual general meeting of the Yorkshire Centre was held on April 5th, Mr. C. N. Hefford (vice-chairman) presiding. A new committee was elected, and at a subsequent meeting of this body the following officers were elected for the ensuing year:—*Chairman*: Mr. W. M. Rogerson (Halifax); *Vice-Chairman*: Mr. E. A. Barker (Barnsley); *Hon. Secretary and Treasurer*: Mr. S. Derwin Jones (Batley).

Mr. Rogerson was re-elected the Centre's representative upon the Council of the I.M.E.A.

A resolution urging the necessity for passing the latest Electricity (Supply) Bill into law was carried unanimously.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.

Mr. Henry Jackson, M.I.E.E., has retired from his position with the London & North Western Railway Co., having reached the age limit. He was telegraph superintendent and electrical engineer to the Lancashire & Yorkshire Railway Co. for a period of 32¼ years, and was transferred to the North Western Co. when the amalgamation took place. He commenced his career with Messrs. Tyer & Co. in 1877, and in 1884 was appointed electrical engineer to the Furness Railway Co. In these early days, in addition to railway telegraphs, he had considerable experience in the electric lighting of docks, petroleum storage, and ship lighting. In 1889 he was appointed to the position on the Lancashire & Yorkshire Railway which he has just resigned. He was chairman of the Railway Electrical and Telegraph Engineers' Conference in 1889, and again in 1915 for the duration of the war. On Tuesday, March 28th, the Railway Electrical and Telegraph Engineers and a few personal friends entertained Mr. Jackson to dinner at the Euston Hotel and presented him with an easy chair and a silver tray suitably inscribed. Mr. Russell, of the Glasgow & South Western Railway, presided, and in making the presentation spoke in high terms of Mr. Jackson's abilities and his readiness at all times to assist and give advice to his colleagues, and wished him every happiness in his retirement. Mr. Fleming, of the Furness Railway, spoke in high terms of his old chief, under whom he served between 1878 and 1889, and pointed out that Mr. Jackson was one of the pioneers in electric lighting, having lighted Ramsden Docks, Barrow, with three separate Siemens dynamos supplying current to three arc lamps on the top of 86-ft. lattice iron standards.

Mr. J. A. Bromley, A.M.I.E.E., general manager of the Keighley Corporation tramways, was appointed, on Friday last, as general manager of the York City tramways.

Faversham Town Council has reduced the salary of the electrical engineer from £450 a year to £416.

Mr. A. Manighetti, after three years in Paris, has left the French technical staff there of the Hewittic Electric Co., Ltd., and is now connected with the same company's London branch (80, York Road, King's Cross, London, N.1), where he will be glad to meet old friends.

Mr. J. C. Austen, manager of Austen & Barnes, Ltd., electricians, has been elected chairman of the Tonbridge Urban Council.

Mr. Richard Fitzhenry, formerly of the English Electric Co., Ltd., Siemens Works, at Stafford, has commenced his duties with Messrs. Callender's Cable & Construction Co., Ltd., Hamilton House, Victoria Embankment, E.C.4, as commercial and technical representative in the London district for cable accessory gear, including joint boxes, network boxes, house service boxes, &c., and cables.

Manchester Corporation Tramways Committee has appointed Major H. Mattinson the chief civil engineer of the Corporation tramways department (see Elec. Rev., April 21st, p. 562) to be general manager, as from July 1st next, at a salary of £1,400 per annum.

Obituary.—Mr. Harold Emmott.—We regret to record that Mr. Harold Emmott (the only son of Mr. Walter Emmott, M.Inst.C.E., M.I.E.E., consulting engineer, of Halifax), died suddenly in his father's office on Thursday last week, at the early age of 35. He was educated at the Higher Grade School and Technical College, Halifax, and at Woodhouse Grove School, Apperley Bridge. He was apprenticed with Mr. Shaw, City electrical engineer, Worcester, and afterwards acted as assistant to Mr. Busby, of the British Insulated & Helsby Cables, Ltd., on London cable contracts, and with the L.C.C. Electricity Department. He joined his father in March, 1913, his first work being the installation of electricity supply in the town of Bingley. He was a member of the 6th London Field Ambulance (T.), transferring to the 2nd Northern General

Hospital, Leeds, and on the outbreak of war he was mobilised, promoted sergeant, and was in charge of the X-ray Department at Beckett's Park, Leeds, until the end of 1915. He then applied for and obtained a commission in the R.E., and served in France until March 23rd, 1917, being invalided out. He then obtained a position as constructional engineer with the Bradford Corporation, rejoining his father some two years ago. He was an Associate Member of the Institution of Electrical Engineers, being admitted a student in 1903. He was a Freemason. The sympathy of all who know his father, Mr. Walter Emmott (one of the oldest members of the profession) will go out to him and the family in their sad bereavement. To the many personal friends of Mr. Harold Emmott his early death will mean much by the loss of a bright, genial and gentlemanly dispositioned member of the electrical fraternity. He leaves a widow and daughter.

CAPTAIN L. C. CARUS-WILSON.—We regret to note that Capt. Louis Charles Carus-Wilson, M.C., R.C.S., assistant experimental officer at the S.E.E., Woolwich, passed away on April 23rd in the Red Cross Hospital for officers at Brighton. Death was the result of tuberculosis, contracted on service in the Near East. Captain Carus-Wilson, who was only 25 years of age, was the second son of Ashley Carus-Wilson, late professor of electrical engineering at McGill University. *The Times*, in referring to his work in connection with wireless telegraphy in the war, says that he received the M.C. "for invaluable services rendered at the Battle of Messines, where, under heavy shell fire during seven days, he showed the greatest skill and resource in using, for the first time in action, the latest invention in wireless signals. . . . . After lecturing on electricity to the British troops at Ohligs, he was recalled, and selected by the War Office in 1919 to be 'the representative British officer' at l'Ecole Supérieure d'Electricité, of Paris. There he won the diploma in radio-telegraphy, &c., of the University of Paris, and passed out of the wireless school first on the long list of foreign officers who completed the course. He was then attached to the Wireless Headquarters Staff at the Horse Guards, and later on, when engaged in original research at Woolwich, was appointed to represent the War Office during the installation at Cairo of the first link of the Imperial Wireless Chain." Capt. Carus-Wilson was an Associate of the Institute of Radio Engineers of America.

Mr. I. STEPHENSON.—The death occurred on April 15th, in his 69th year, of Mr. Isaac Stephenson, electrical contractor, for many years in business in Flowergate, Whitby.

Will.—MR. ALEXANDER MCGEOCH, of Birmingham (W. McGeoch & Co.) left £37,631.

NEW COMPANIES REGISTERED.

Plant and Supplies, Ltd (181,109).—Private company. Registered April 12th. Capital, £4,000 in £1 shares. To carry on the business of electrical and mechanical engineers, dealers in electrical and mechanical plant and engineering supplies, &c. The subscribers (each with one share) are: A. P. Pope, Toddington, Beds., engineer; J. P. Southwell, 18-19, Ironmonger Lane, E.C., C.A.; A. P. Pope is the first director. Registered office: 12 and 13, Henrietta Street, W.C.2.

Instrument Screw Co., Ltd. (181,233).—Private company. Registered April 20th. Capital, £3,000 in £1 shares. To carry on the business of manufacturers of screws and parts for electric and scientific instruments, and small engineering and scientific apparatus, &c., in the U.K. or elsewhere. The first directors are: E. Homberger, 17, Kenton Road, Harrow-on-the-Hill (managing director and chairman); H. Booty, 25, Kenton Road, Harrow-on-the-Hill. Secretary: H. C. Booty. Registered office: Stanley Road, South Harrow.

Haywards Heath and District Electric Supply Co., Ltd. (181,143).—Registered April 13th. Capital, £30,000 in £1 shares. To acquire from E. A. Bridge, H. Dearden, H. Finch, T. White and E. Prior, with the consent of and on such terms and conditions as may be approved by the Electricity Commissioners, the undertaking authorised by the Haywards Heath and District Electricity Special Order, 1922, and to carry on the business of suppliers of electricity in all its branches. The first directors are: E. A. Bridge, Naldretts, Hurstpierpoint; H. Dearden, Lyhoath, Haywards Heath; H. Finch, Hornbeam, Haywards Heath; T. White, Grenville, Haywards Heath; E. Prior, Church Road, Burgess Hill. Minimum cash subscription, £7,000. Qualification, £500. Secretary: O. S. Jaques. Registered office: Hornbeam, Perrymount Road, Haywards Heath, Sussex.

Power and Traction Finance Co., Ltd.—Registered on April 20th by Messrs. Linklaters and Paines, solicitors, 2, Bond Court, E.C.4, as a "private" company with a nominal capital of £250,000 in £1 shares. The objects as defined in the memorandum of association are (*inter alia*): To seek and secure openings for the employment of capital in any part of the world, to apply for and turn to account any Act of Parliament, decree, concession, right or privilege, to carry on, finance, assist or participate in trading, financial, commercial, industrial, manufacturing, mining and other businesses, works, contracts and undertakings, and to carry on business as exporters and importers of any articles and as general engineers and contractors, and any business usually carried on by trust, finance, land, mortgage and agency companies and bankers, to promote companies, to purchase, underwrite, subscribe for, hold and deal in investments and securities of all kinds, and to acquire, construct, equip, carry out, administer and control public works and conveniences of all kinds. The subscribers to the memorandum of association (each signing for one share) are two clerks. The first directors are: Wm. L. Hichens, Sir John Hunter, K.B.E., the Rt. Hon. Lord Meston, K.C.S.I., P. J. Pybus, C.B.E., Sir Hugh Reid, Bt., C.B.E., and J. Sampson, C.B.E. No share qualification is required. The remuneration of the directors is to be determined by the company in general meeting. The directors may exercise all the powers of the company to borrow or raise money and to mortgage or charge the undertaking, property and uncalled capital of the company, and to create and issue debentures, debenture stock and other securities of any description. The company is empowered (on the recommendation of the directors) to pass a resolution to capitalise undivided profits and to allot bonus shares and securities. Share transfers are restricted. Shares proposed to be transferred must be offered first to existing shareholders at a price to be fixed by the proposing transferor or by arbitration. No notice of situation of registered office was on the file to April 24th, on which date the file first became available for inspection. The file number is 181,220.

Kohler Co., Ltd.—Registered as a "private" company on April 20th by Messrs. H. C. Davies & Son, 222, Strand, W.C.2, with a nominal capital of £10,000 in £1 shares. The objects are: To act as importers and exporters, as principals or agents, of wares and goods manufactured or sold by the Kohler Co., of Kohler, Wisconsin, U.S.A., to manufacture and deal in Kohler automatic power and light machines, plant and accessories, electrical and other machinery, internal combustion, gas and other engines and dynamos, Kohler enamelled plumbing ware, baths, basins, lavatories, sanitary ware and fittings, pipes, tubes, brass, iron and other metal and enamelled goods, household articles, vacuum cleaners, implements, pumps, agricultural and domestic machinery and appliances, &c. The first directors are: W. J. Kohler, 10, High Street, Kohler, Wisconsin, U.S.A., manufacturer; W. B. Clark, Bank House, Tring, Herts., merchant; and J. Peacock, 14d, Gleneldon Road, Streatham, S.W.16, barrister. Mr. Peacock is a British subject by birth, and the other two are citizens of the U.S.A. by birth. Qualification: one ordinary share. Remuneration, £1 each per annum, or as the company may decide. The registered office is at 329, High Holborn, W.C. The file number is 181,235.

James Gordon & Co., Ltd. (181,247).—Private company. Registered April 21st. Capital, £15,000 in 8,000 7½ per cent. preference shares of £1 each and 14,000 ordinary shares of 10s. each. To adopt agreement with J. Gordon and J. J. Lassen and to carry on the business of founders, mechanical, electrical, and marine engineers, manufacturers of water turbines, governors, pipe lines, and other water-power machinery, &c. The subscribers (each with one ordinary share) are:—S. Pennells, 75, Bulwer Road, Leytonstone, E.11, law clerk; B. H. Gower, 136, Colney Hatch Lane, N.10, managing clerk. The life directors are: J. Gordon (chairman) and J. J. Lassen. Qualification of ordinary directors, £250. Registered office: Windsor House, Kingsway, W.C.2.

Peacehaven Electric Light and Power Co., Ltd.—Registered as a public company on April 21st with a nominal capital of £20,000 in 15,000 10 per cent. preference shares of £1 each and 20,000 ordinary shares of 5s. each. To acquire certain plant and machinery and the right to supply electric light and power to owners, leaseholders, and tenants on the "Peacehaven" estates and elsewhere, and to adopt an agreement with the South Coast Land and Resort Co., Ltd. The minimum cash subscription upon which the directors may proceed to allotment is £7. The first directors are: Rt. Hon. Lord Teynham, 119a, Mount Street, W. (director, Fanti Consolidated Mines, Ltd.); C. W. Neville, Avenue Chambers, 4, Vernon Place, W.C.1. (director of South Coast Land and Resort Co., Ltd.); C. F. Gold, Avenue Chambers, 4, Vernon Place, W.C.1 (director of South Coast Land and Resort Co., Ltd.). Qualification (except first directors), £100. Remuneration, £300 per annum, divided between them. The registered office is 4, Vernon Place, W.C.1. The file number is 181,255.

Bideford and District Electric Supply Co., Ltd. (181,201).—Registered April 19th. Capital, £25,000 in £1 shares (7,500 preference and 17,500 ordinary). To acquire from S. I. Knill the rights, benefits, and interests referred to in three agreements, two dated April 7th and December 15th, 1921, between himself and the Borough of Bideford, and one dated January 9th, 1922, between himself and the Urban District Council of Northam; to adopt three agreements dated February 9th, February 9th, and February 14th, 1922, with the said S. I. Knill, Crompton & Co., Ltd., and Bartlett, Bayliss & Co., Ltd., and to carry on the business of suppliers of electricity in Bideford and elsewhere. The first directors are: Major W. Ascott, O.B.E., "Westbridge," Bideford; E. W. S. Bartlett, "Glenburnie," Bideford (director Bartlett, Bayliss & Co., Ltd., &c.); J. U. Fulford, J.P., "Southcott," Bideford (director J. U. Fulford & Sons, Ltd.); J. N. A. Houblon, M.I.E.E., "Boxford," Newbury, Bucks. (director Twiss Electric Transmission Co., Ltd., and other companies); Sir Robert M. Hyslop, J.P., C.C., "Cedar Lawn," Beckenham (director United Kingdom Provident Institution and various companies); H. N. G. Stuckley, J.P., "Moreton," Bideford (director Bartlett, Bayliss & Co., Ltd.); G. C. Smyth-Richards, C.B.E., "Filleigh," South Molton (director Bartlett, Bayliss & Co., Ltd., and Lynton Lift Co., Ltd.). Minimum cash subscriptions, 7 shares. Qualification, £200. Secretaries: R. & R. B. Blackmore. Registered office: Alexandra House, The Quay, Bideford, Devon.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Newcastle and District Electric Lighting Co., Ltd.—Mortgage debenture dated March 27th, 1922, to secure £10,000 and further sums not exceeding in the aggregate £20,000, charged on the company's undertaking and property, present and future, including uncalled capital and all moneys resulting from any compulsory sales under any contract prior to above date or any provisional order or Act of Parliament, subject to certain prior charges. Holder: J. Priestman, "Cliffside," Roker, Sunderland.

Omega Lamp Works, Ltd.—Particulars of £1,000 debentures authorised April 11th, 1922; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

Thomas Wilkinson (Arnside), Ltd.—Debenture and as collateral security thereto, a mortgage, both dated April 7th, 1922, to secure £10,250, charged on the company's undertaking and property, present and future, including uncalled capital, and the electrical works and land at Arnside, Westmorland. Holders: Bank of Liverpool and Martins.

Lancashire United Tramways, Ltd. (87,044).—Return dated March 13th, 1922. Capital, £200,000 in £1 shares. 192,878 shares taken up £7 paid. £192,871 considered as paid. Mortgages and charges: Prior lien debenture stock £250,000 (a further £40,000 of this stock has been deposited as security for possible advances); second mortgage debenture stock £296,500; deferred debenture stock issued, having no charge over the assets of the company, £83,330.

Cambridge Electric Supply Co., Ltd. (36,457).—Return dated March 15th, 1922. Capital, £100,000 in £10 shares. 9,911 shares taken up. £99,110 paid. Mortgages and charges, £57,450.

Burgess Hill and District Electric Supply Co., Ltd. (85,698).—Return dated March 10th, 1922. Capital, £6,000 in £1 shares (3,000 ordinary and 3,000 preference). All shares taken up. £5,900 paid. £100 considered as paid. Mortgages and charges, £1,200.

W. S. Laycock, Ltd. (68,203).—Return dated January 2nd, 1922 (filed March 8th). Capital, £150,000 in £1 shares (100,000 ordinary and 50,000 preference). All shares taken up. £50,007 paid. £99,993 considered as paid. Mortgages and charges, £216,800.

Spicer & Co., Ltd.—Satisfaction to the extent of £900 on February 2nd, 1922, of debentures dated February 23rd, 1915, March 16th, 1916, and August 15th, 1917, securing £1,350.

Sun Electrical Co., Ltd.—Satisfaction to the extent of £275 on March 31st, 1922, of debenture stock dated March 31st, 1911, securing £7,000.

Steel Wing Co., Ltd. (formerly Krieger Electric Carriage Syndicate, Ltd.).—D. H. Emby, of 48a, Gillingham Street, S.W., ceased to act as receiver or manager on April 12th, 1922.

CITY NOTES.

West London & Provincial Electric Supply Co., Ltd.

Mr. Harry Kahn presided at the annual meeting on April 19th. In presenting the report and accounts, he said that the balance at profit and loss, £5,209, was practically the same as before. The division of this profit, however, was a different matter, as last year besides the current interest on the funding certificates, the whole of the arrears were paid off. Accordingly the directors now recommended a dividend of 6 per cent. on the ordinary shares; 6 per cent. on the cumulative preference shares; and 4½ per cent. interest on the funding certificates; a balance of £356 was carried forward. The chairman then referred to the working results of the Chiswick Electricity Supply Corporation, Ltd., the whole of the capital of which is held by the West London Co.; this report was dealt with in our issue of April 14th (p. 530). The report and accounts were adopted and the retiring directors re-elected, and at a subsequent extraordinary meeting it was unanimously agreed to increase the directors' remuneration from £1,200 to £1,800 per annum.

National Electric Construction Co., Ltd.

For the year ended December 31st, 1921, there was a profit of £9,681, plus £8,538 brought forward. The directors recommend that there be put to depreciation on free wired installations £1,000, to general reserve £3,000, to reserve for equalisation of dividends £3,000, to reserve, Dewsbury and Ossett Tramways £1,300. A dividend of 6 per cent. requires £5,100, and there is to be carried forward £4,820. The company is financially interested in the following undertakings:—Rhondda Tramways Co., Ltd.; Torquay Tramways Co., Ltd.; Mexborough and Swinton Tramways Co.; Musselburgh and District Electric Light and Traction Co., Ltd.; Dewsbury and Ossett Tramways; City of Oxford Motor Services, Ltd.; Bo'ness and Carnarvon Electricity Undertakings; and Wisbech Electric Light & Power Co., Ltd. The coal strike and subsequent trade depression adversely affected the results, but the profits generally have been satisfactory, the net revenue from interest on investments, less interest paid, being £5,390.

River Plate Electricity Co., Ltd.

According to the *Financier*, the net revenue for 1921 from all sources (including £35,457 arrears of interest for years 1914-19 upon 5 per cent. obligations of German Trans-Oceanic Electric Co.) amounts to £80,693, plus £6,982 brought forward. There has been transferred to general reserve £30,000, as well as other sums amounting to £10,654, held in suspense to cover certain contingencies. The directors recommend a dividend of 6 per cent. upon the 6 per cent. preference shares and a dividend of 7 per cent. for year on the ordinary, reserving for taxation £10,000, carrying forward £9,104. The board also recommends that £49,573, part of general reserve fund, be capitalised and divided among ordinary stockholders. The board has not been advised that all formalities connected with transfer of assets of German company to Spanish company have been completed, and therefore the contract between the company and Compania Hispano-Americana de Electricidad, referred to in last year's report, has not yet been formally declared effective. It is, however, anticipated that all formalities will be completed by an early date, and in the meanwhile the Spanish company has punctually met all interest payments upon outstanding obligations and also the first annual repayment of principal due on October 1st last.

Southern Brazil Electric Co., Ltd.

Meetings of the 6 per cent. mortgage debenture-holders, 8 per cent. 10-year noteholders and shareholders of this company are to be held to-day to consider a scheme of arrangement which provides that the redemption of the first debentures be suspended for a period of four years; that the £182,800 8 per cent. notes be converted into £182,800 10 per cent. cumulative preference shares, ranking for dividend as from July, 1926; and that the present paid-up share capital, viz., £650,000, be reduced by 50 per cent., making the present £1 shares 10s. shares fully paid, and the amount thus written off, viz., £325,000, with the whole or part of the sum of £70,050 standing to debenture redemption reserve, together £395,050, to be utilised (says the *Financier*) for writing off or writing down the following: The debit balance on profit and loss account to December 31st, 1920, of £37,850; the estimated loss for 1921, £30,000; preliminary expenses, £25,000; discount on issue of debentures and expense of further issue, £36,087; 8 per cent. notes issue expenses, £440; depreciation reserve, to be applied in writing down investments and assets in Brazil, £265,673.

Provincial Cinematograph Theatres, Ltd.—Net profit for the year ended January 31st, 1922, £100,780, plus £36,658 brought forward. The profit is not sufficient to allow of the payment of the half-yearly dividend (due January 1st) on the cumulative participating preferred ordinary shares, or of a dividend on the ordinary shares. The Government Amusement Tax was more than the entire profits. For the preceding year the dividend was 12 per cent.

Cuba Submarine Telegraph Co., Ltd.—The receipts for 1921 were £65,974 and the expenses £33,010. After providing £8,502 for income tax and £9,334 on account of E.P.D., the balance is £15,128 plus a difference in exchange of £6,959 and £26,646 brought forward, making £48,732. £15,000 has been added to the general reserve fund. Interim dividends were paid at the rate of 10 per cent. per annum, less income tax, on the preference shares, and at the rate of 5 per cent. per annum, free of income tax, on the ordinary shares, and the directors recommend final dividends at the same rates and a bonus of 4s. per share on the ordinary shares, free of income tax, leaving £16,532 to be carried forward, subject to excess profits and other duties. The new section between Cape Cruz and Santiago has been laid at a cost of £37,562, and several repairs, including that of the Cienfuegos-Santiago 1905 cable, have been carried out during the year, costing £14,690. Both these amounts have been charged to the reserve fund.

Italian Companies.—The following companies have raised their capital: Società Idroelectrica dell'Ossola, Milan, from 5 to 20 million lire; Manifattura Ceramica Pozzi, Turin, from 2 to 3½ million lire; Società Industrie Telefoniche Duglio, Milan, from 6 to 7 million lire; Società Anonima Idroelettrica Veneta, Venice, from 5 to 50 million lire; Società Anonima Volsina, Rome, from 5 to 6 million lire; Società Anonima Idroelettrica Valle del Liri, Rome, from 100,000 to 5,000,000 lire; Società per Imprese ferroviarie e Lavori pubblici, Rome, from 100,000 to 2,500,000 lire; Società Anonima per la Produzione di Materiali isolanti per l'Elettricità, Genoa, from 300,000 to 600,000 lire; Elettricità e Gaz Novi Ligure, Genoa, from 1,000,000 to 2,000,000 lire; and Ferrovie Elettriche Liguri, Genoa, from 600,000 to 1,200,000 lire.

Austrian Company.—The report of the Felten and Guilleaume Co., of Vienna, states that the results obtained in 1921 were considerably better than in the preceding year. With the exception of slight stagnation in the middle of the year all the departments were well occupied and the new financial year had been entered upon with a good stock of orders. After having made provision for depreciation the accounts show net profits of 155,970,000 Austrian crowns and a dividend at the rate of 50 per cent. has been declared, as compared with 30 per cent. in 1920.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 148a:—

City of Wellington 5½ per cent. debentures, 1940.—£519,000 Wellington City Electric Power Station Construction and Tramways Improvement Loan, 1920; and £174,000 Wellington City Water Supply Loan, 1920, issued at 98 per cent., partly paid and fully paid, after issue of Allotment Letters.

The undermentioned have been ordered to be officially quoted:—

Brush Electrical Engineering.—248,075 ordinary shares of £1 each, fully paid (Nos. 210,489 to 458,563).

Lancashire Electric Light & Power.—£535,000 7½ per cent. prior lien debenture stock.

British Electric Transformer Co., Ltd.—The accounts for the year ended December, 1921, show that after paying all manufacturing costs and expenses of administration there is a net profit of £91,416, plus £6,178 brought forward. It is proposed to place £15,000 to reserve, £4,000 to depreciation reserve; £21,000 is required for the preference dividend of 7 per cent.; the dividend on the ordinary shares is 10 per cent. for the year, plus a bonus of 2½ per cent. (£40,625); £4,261 extra remuneration to directors; carried forward £12,708. Meeting: May 2nd.

Greenock and Port Glasgow Tramways Co., Ltd.—After providing for all expenses, mortgage interest, &c., and setting aside £15,675 for renewals, there is a surplus on the year's working of £7,482, plus £410 brought forward. It is proposed to put to sinking fund for loan redemption, £1,796, and to reserve, £1,000. After paying a dividend of 5 per cent. on the preference shares, £1,597 is to be carried forward.

New Issue.—There has recently been offered in London, on behalf of the City of Wellington, New Zealand, £693,000 5½ per cent. debentures at 98 per cent. (£519,000 Wellington City Electric Power Station Construction and Tramways Improvement Loan, 1920, and £174,000 Wellington City Water Supply Loan, 1920), payable £5 per cent. on application, £43 on allotment, and £50 on June 16th. The debentures of the two loans will, as far as possible, be allotted *pro rata*.

Calcutta Electric Supply Corporation, Ltd.—At the meeting early in May the directors will recommend a final dividend on the ordinary shares for the half-year ended December 31st, 1921, at the rate of 6 per cent. actual, making 10 per cent. for the year, plus a bonus of 1 per cent. Relief will be given, as heretofore, in respect of Indian taxation.

Oriental Telephone & Electric Co., Ltd.—Subject to final audit the directors recommend final dividends of 3 per cent. on the preference shares, less income tax (making 6 per cent. for the year), and 6 per cent. on the ordinary, making 10 per cent. for the year, free of tax; also a bonus of 2 per cent. on the ordinary shares, free of tax.

Bell's United Asbestos Co., Ltd.—Total dividend for the year 10 per cent., carrying forward £34,013.

Ever Ready Co. (Great Britain), Ltd.—The directors recommend the payment of a final dividend of 5½ per cent. on the preference shares, making 9 per cent. for the year ended March, 1922, and 9 per cent. on the ordinary shares. The meeting will be held on May 31st.

Montreal Light, Heat and Power Co.—Quarterly dividends of 1¼ per cent. on the consolidated shares and 2 per cent. on the common shares have been declared.

STOCKS AND SHARES.

Tuesday Evening.

Fresh accessions of strength mark all the investment departments of the Stock Exchange. It will, perhaps, show more clearly than anything else what is the present state of affairs if an incident is related which occurred in a stockbroker's office one day this week. A client sent in to the broker a cutting from the Electrical Review in which it was mentioned that five of the principal electricity supply companies' shares could be obtain at prices which would yield 8 per cent. on the money. When this was written the shares were, of course, all on offer. Within the course of a few days, not only had the supply been absorbed, but prices had moved up, on to a 7 per cent. level, and, moreover, there was not one in that quintette of shares which could be bought at all. The client complained bitterly at being unable to get the offer of shares which he knew, through the medium of the Review, were on offer at the time, but, as the dealers remark, they cannot manufacture shares, and if people decline to sell, it is impossible to supply would-be purchasers.

In the light of this incident, it is scarcely necessary to remark that the quotations in the accompanying price-lists do not necessarily imply that shares can be obtained at the prices named, or, indeed, that the shares can be obtained at all. The investor sees the gilt-edged stocks rising to levels at which the return on the money comes to less than 5 per cent., and he asks, naturally enough, what inducement there is for him to sell sound shares unless he knows of something equally attractive into which he can put the money. New Zealand succeeded in floating a loan this week of five million pounds in 5 per cents. for which the Colony received 100 per cent., setting a fresh high standard of yield for these days, and bringing about further improvement in all similar securities. The difficulty of knowing what to do with the money is almost as great as knowing how to obtain that money in the first place. One has heard the semi-humorist complain that money is useless nowadays, because it is impossible to find profitable employment for it.

St. James's & Pall Mall shares at 8 are 15s. higher. Metropolitans at 5¼ are 5s. up, and so are Londons at 4⅛. County ordinary rose to 26s. 3d. bid, Citys are ½ up at 37s. 6d., Kensingtons at 6⅜ show a gain of 5s. This kind of thing is common throughout all the lists of good industrial stocks and shares.

Manufacturing shares are affected sympathetically by the strength of the supply descriptions. General Electric at 24s. 3d. are 1s. 6d. up, but the principal movement is in English Electrics which have risen no less than 6s. to 16s. 3d., while the preference at 17s. 6d. are 1s. 3d. better. Electric Constructions at 1 3/16 are 1s. 3d. higher, and British Aluminiums gained half-a-crown at 16s. 3d. Edisons improved to 5s., and the cable manufacturing shares are also a good market, Henleys hardening to 2⅛. Telephone Manufacturing Notes have risen to 108, with little supply on offer. British Electric Transformers attracted attention by reason of the report, which shows the company to have made a net profit of £83,000—an increase of £18,000 over the figures of the preceding year. The dividend is maintained at 12½ per cent., £15,000 is put to reserve and the substantial sum of £12,700 goes forward. The price of the shares is about 24s.

River Plate Electricity stock has risen several points to 120, on the declaration of a dividend of 7 per cent. for the year, and Canadian General Electrics are firm at 103, although the report now to hand does not exhibit those indications of progress which are obvious in many of the British electrical undertakings. The company is paying 8 per cent. for the year, a reduction of 2 per cent., and even to do this the surplus has to be drawn upon to the extent of 222,000 dollars. The reserve account, however, still stands at the substantial amount of seven million dollars.

The Ever-Ready Co. announces a dividend of 9 per cent. on the ordinary shares, an increase of over 4 per cent. as compared with that of a year ago, and the 7 per cent. participating preference get an additional 2 per cent. by reason of their rights. The ordinary shares are quoted at half-a-guinea: the preference are about 10s.

Underground Electric income bonds are better at 77½, and Central London assented ordinary rose to 66, but otherwise the market is inclined to be dull. Metropolitan Consolidated, in which there seems to be something of a weak bull account, gave way to 41. The company received applications for nearly 8½ million pounds sterling of the £600,000 5 per cent. preference stock offered a fortnight ago. A premium of 6½ points was promptly established, and has been steadily held. British Columbia Electric stocks are all substantially higher, the deferred leading with a gain of five points at 76½. On many previous occasions some surprise has been expressed here at the way in which the stock appeared to be overlooked by the speculative investor, and the rise of the past month will surprise nobody who has followed with any attention the fortunes of the company. Mexicans are quieter after their boom of the previous week. Anglo-Argentine Tramways 5 per cent. debenture is no less than 6 points higher at 83½.

Marconis have taken a jump to 50s., showing a gain of 6s. 3d. on the week. Radio common shares, which were a dull market at 14s. 6d. just lately, are now 19s. 9d., though the preference shares at 15s. have scarcely moved. Other Marconi shares are also better, Canadians being 11s. 3d. There is no diminution of strength in the cable market, Eastern ordinary and Globes both showing improvements. Chile Telephone advanced to 6, and of the stocks in the American lines, Anglo-American deferred is better at 22⅞.

Armament shares went ahead briskly until the labour outlook became overcast again, when Armstrongs and Vickers both gave way from the best prices touched. The rubber share market is tolerably steady, owing to the unexpectedly good showing made by various rubber-producing companies, whose reports are now making their appearance. The price of the produce gives little encouragement to the market, but rubber shareholders are well-accustomed to cheques on the Bank of Hope. The engineering group is steady, and business all round in stocks and shares shows a very noticeable improvement as compared with what it was at the beginning of the year.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend. 1920.	Dividend. 1921.	Price April 25, 1922.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	12	12	7½	—	£8 0 0
Charing Cross Ordinary	8	9	6½	—	7 4 0
do. do. do. 4½ Pref.	4½	4½	3⅝	+ ⅛	6 4 2
Chelsea	6	6	5¼	—	5 9 1
City of London	14	14	11	+ ⅛	7 9 4
do. do. 6 per cent. Pref.	6	6	21/-	—	5 14 2
County of London	8	8	1 5/16	+ 1/16	6 2 0
do. do. 6 per cent. Pref.	6	6	1	—	6 0 0
Kensington Ordinary	9	10	6⅝	+ ½	7 11 0
London Electric	2½	4	1 11/16	—	7 2 3
do. do. 6 per cent. Pref.	6	6	4⅜	+ ½	6 9 9
Metropolitan	7	7	5¼	+ ¼	6 16 7
do. 4½ per cent. Pref.	4½	4½	3⅝	—	6 5 2
St. James' and Pall Mall	12	12	8	+ ⅜	7 10 0
South London	7	7	5⅜	—	8 7 0
South Metropolitan Pref.	7	7	1¼	—	6 4 5
Westminster Ordinary	10	10	7	—	7 2 10
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	102	—	5 17 8
do. Def.	1½	34/3	22⅞	+ ⅛	7 18 0
Chile Telephone	6	6	6	+ 1/16	5 0 0
Cuba Sub. Ord.	7	7	8⅞	+ ⅛	8 0 0
Eastern Extension	10	10	19⅜	—	5 4 0
Eastern Tel. Ord.	10	10	195/-	+ 2	5 2 3
Globe Tel. and T. Ord.	10	10	19⅜	+ ⅛	5 3 3
do. do. Pref.	6	6	11½	—	5 7 7
Great Northern Tel.	23	24	31½	—	7 12 8
Indo-European	10	10	28	—	6 11 7
Marconi	25	15	2/6	+ 3/16	6 0 0
Oriental Telephone Ord.	13	13	9½	—	*5 18 0
United R. Plate Tel.	8	8	7½	—	*5 12 8
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	19⅜	—	*5 3 3
Home Rails.					
Central London Ord. Assented	4	4	66	+1⅛	6 1 3
Metropolitan	1½	2½	41	— ¼	5 9 9
do. District	Nil	1	34	—	2 18 10
Underground Electric Ordinary	Nil	Nil	3⅜	—	Nil
do. do. "A"	Nil	Nil	7/-	—	Nil
do. do. Income	2	4	77½	+1	*5 3 3
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref.	6½	12½	8⅜	+ ⅛	7 11 9
do. do. 2nd Pref.	Nil	5½	4	+ ¼	6 17 6
do. do. 5 per cent. Deb.	5	5	83½	+6	6 1 3
Brazil Tractions	Nil	Nil	5⅝	+ ⅛	Nil
British Columbia Elec. Rly. Pfce.	5	5	77⅝	+4	6 9 0
do. do. Preferred	6	9/-	73⅛	+3/4	*6 5 10
do. do. Deferred	8	12/-	76⅛	+5	*8 2 5
do. do. Deb.	4½	4½	7⅜	—	5 18 1
Mexico Trams. 5 per cent. Bonds	Nil	Nil	70½	—	—
do. do. 6 per cent. Bonds	Nil	Nil	85⅝	+1	Nil
Mexican Light Common	Nil	Nil	21⅛	—	Nil
do. Pref.	Nil	Nil	50⅝	+2	Nil
do. 1st Bonds	Nil	5	74⅝	—4	6 14 3
***Manufacturing Companies**					
Babcock & Wilcox	15	15	9	—	5 6 8
British Aluminium Ord.	10	10	4½	+ ⅛	—
British Insulated Ord.	15	15	2	—	7 10 0
Callenders	15	15	2	—	7 10 0
" 6½ Pref.	6½	6½	1⅛	—	5 15 7
Crompton Ord.	10	10	15/-	—	13 6 8
Edison-Swan	10	—	5/-	+6d.	—
do. do. 5 per cent. Deb.	5	5	62	—	8 1 4
Electric Construction	10	10	1 3/16	+1/3	8 8 5
English Electric	8	8	16/8	+6/-	9 17 0
do. Pref.	6	6	⅞	+ 1/16	6 17 2
Gen. Elec. Pref.	6½	6½	20/9	—	6 5 4
do. Ord.	10	10	34/3	+1/6	8 4 8
Henley	15	15	2⅛	+ 1/16	7 1 2
do. 4½ Pref.	4½	4½	4½	+ ⅛	5 6 0
India-Rubber	10	—	1⅛	—	—
Met.-Vickers Pref.	8	8	2⅝	—	6 14 9
Siemens Ord.	10	10	97/6	—	*7 5 5
Telegraph Co	20	20	35½	+ ½	*4 16 2

* Dividends paid free of Income Tax.

THE ELECTRICAL HEATING OF BUILDINGS.

A paper read at the meeting of the National Association of Supervising Electricians on March 14th by Mr. W. W. Nobbs, on "The Determination of Heat Loss from Buildings, with Special Reference to Electrical Heating," is a reminder that if electrical heating, at any rate on a large scale, is to make rapid headway, attention will have to be given to the scientific and fundamental principles underlying heat loss from the walls of rooms and buildings. In other words, we must abandon the more or less "hit or miss" methods which have largely been adopted in the past. This criticism, however, applies not only to electric heating, but also to other forms of heating, although perhaps in a less degree. Mr. Nobbs is a past president of the Institution of Heating and Ventilating Engineers, and he will agree that it is only in recent years that heating and ventilating engineers themselves have begun to inquire into this aspect of the heating problem on scientific lines. The Institution of Heating and Ventilating Engineers, however, has done good work in this direction through the medium of its Research Committee, though hampered from the point of view of funds, as most research committees are. Nevertheless, it must not be inferred from the paper—and we are sure that was not Mr. Nobbs's intention—that electrical engineers have ignored known fundamental facts, or, rather, existing knowledge of these fundamental facts. The truth is that this knowledge has not existed in the past, and although a great deal more information on questions relating to heat interchange and heat transmission through the various materials of which walls are made is now available than was the case only a few years ago—solely through the work of the Institution of Heating and Ventilating Engineers—yet the available information is at present more or less in its preliminary stages of accumulation. Nevertheless, it cannot be denied that sufficient is now available to justify a paper on the subject to electrical engineers pointing the way to a better utilisation of electrical energy for heating purposes.

The author pointed out that in the early days of electrical heating, electricians were confronted with two difficulties. In those days the heater usually consisted of a lamp radiator, and the first difficulty was to overcome the erroneous idea, largely created by electricians themselves, that electricity gave off no heat. The second difficulty arose from the lack of experience and data in estimating the amount of electrical energy necessary to be expended to produce or maintain a given heating effect. For want of other data, recourse was evidently had to hot-water engineers' text-books and catalogues, and, as a result, a highly-fallacious empirical formula connecting the power of the heater with the cubic capacity of the room obtained much credence. For instance, it became common practice to allow one watt per cubic foot of space to be heated. Thus, for a room, say 20 ft. by 10 ft. by 10 ft., having 2,000 cubic feet content, the electrician would probably suggest two 4-lamp radiators, each lamp consuming 250 watts. From considerations shown later in the paper—and arrived at, it must be admitted, long after the days the author was speaking of in the early part of the paper—it would be seen that the loss of heat or heat requirements of a room or building were not directly proportional to its volumetric capacity. Indeed, it may easily be shown that two rooms of equal cubic content may have anything up to 100 per cent. difference in heat requirements.

This immediately brings us to the question of heat transmission through building materials, in respect of which a table of coefficients has been prepared, but even these are not the sort of data which can easily be applied by the average electrician dealing with the heating of small rooms. These heat transmission coefficients apply to still air, and in figuring the heat losses of a building it is customary, for the purpose of applying these coefficients, for heating and ventilating engineers to assume that each room has a southern and protected aspect, and then add a percentage to cover the additional loss due to exposure and aspect, according to the location of a room. "The exact amount to be added is largely a matter of judgment," says the author. Then there is the question of leakage losses and air interchange to be taken into account, and the paper gives in a convenient form a schedule of air interchanges which it is hoped will provide data and methods which conform to modern practice in estimating the amount of heat lost from a room or building under a steady state of heat flow.

The paper gives two examples to illustrate the methods described previously by the author and to point out the variance in heating requirements that may occur in practice between rooms of the same size. Taking a room, 20 ft. by 11 ft., used as a bedroom, with fireplace, on the first floor of a three-storey residence having one short wall exposed to south aspect, warmed rooms adjoining the long walls, an unheated corridor abutting against the other short wall, a cold attic above, and a warmed room below, the heat loss would be approximately 8,000 B.th.u. per hour, or a loading of 2.35 kW, and the case would be met by a 3-kW radiator. In the second example, the same room was assumed to be a typical corner room on the ground floor of an eight-storey office block, with an extraction ventilator in the corner, a warmed room on the short side, a corridor on the other, a cold basement below, and warmed rooms above. In this case the heat loss would be approximately 15,000 B.th.u. per hour, and a 5-kW loading would be required.

Whilst thoroughly agreeing with the need for dealing with the problem of electric heating on more scientific lines than are often followed, one wonders whether the average local wiring contractor, for instance, when asked to install an electric radiator in a bedroom, could fairly be expected to go into the job in quite such a scientific manner as was suggested. It rather appears that by the time the various factors had been calculated, the time occupied would have wiped out the profit; or, alternatively, if the job had to bear the cost of the time taken in arriving at whether a 3-kW or a 5-kW heater was required, the price would be so high that the contractor would not get the job. With large buildings, of course, the position would be different, but one does see a difficulty in applying these highly scientific methods in the case of one or two rooms in small houses, and it is not inconceivable that more rough-and-ready methods will continue to be adopted in those cases. This, however, is not intended in any way as an adverse criticism of the paper, or of the advocacy of the adoption of scientific principles.

Quite a number of questions were put to Mr. Nobbs during the discussion, and one speaker mentioned that he had found a fan being used in an office on a fairly cold day. He had noticed that the fan was playing on a small steam radiator, and by that means the room was said to be warmed in half the time taken to warm it by ordinary convection. Mr. Nobbs explained that the steam-heated radiator was flexible in its heat-emitting power, whereas the heat flow from an electric radiator was practically constant, and that by blowing air over a steam radiator the heat emission could be increased, and also the steam consumption, but it could not be done electrically. The previous speaker jocularly suggested, therefore, that if a man had a small hot-water or steam radiator in his office, and asked him to put in an electric radiator, he should offer him a fan instead.

Another question brought the admission from Mr. Nobbs that for residential and office heating, &c., electricity, at present rates, was only practicable where one considered intermittent heating. But there were plenty

of large buildings wherein electric heating was commercially practicable, such as theatres. In such a building it was not necessary to heat continuously, because when it was filled with people the problem was rather to cool the air than to heat it. In all these things one's judgment had to be used, as to the capacity of the heaters. He had just finished a report in connection with a large theatre, in which he had recommended the installation of electric heaters which would amount to about 72 kW, and it was a proposition to consider whether to use 72 kW for a couple of hours a day or to use a ton of fuel per day. At present this particular theatre was using about six or seven tons of coal per week, and had to employ a stoker to maintain the same conditions as would be obtained by those 72 kW for two hours a day. With regard to heating in conjunction with ventilation, he mentioned the re-arranging of the heating some time back at the Criterion Theatre, London. The building was heated by fans blowing over electrical convectors, and the air so circulated had the effect of absorbing the moisture in the air, and thus keeping the air in a proper condition.

Speaking on the paper, Mr. G. C. Nobbs (the author's brother) said the object of the paper was to give the engineer data which would enable him to make his calculations, and added that it would also give him the means whereby he could check manufacturers' catalogues. He also pointed out, with reference to remarks made as to the capacity of a radiator installed in a bedroom, that the heat necessary need not be concentrated in one radiator, but could be distributed throughout the room. Although the maximum amount of heating was not required in a bedroom in the ordinary way, in the case of illness it was an advantage to have the heaters distributed about the room in the cold spots where they were most needed.

HYDRO-ELECTRIC POWER DEVELOPMENTS IN INDIA.

The first Triennial Report of the Hydro-Electric Survey of India* bears witness to the great amount of work already accomplished under the direction of Mr. J. W. Meares, C.I.E., M.I.E.E., Chief Engineer of the Survey, and Electrical Adviser to the Government of India. The area with which the Survey is to some extent concerned is about 1,800,000 sq. miles, of which over 1,000,000 sq. miles is under British administration. From this immense field, in the face of many difficulties, there has been collected relatively detailed information concerning 190 hydro-electric power sites (estimated to be capable of yielding 1,194,280 kW minimum continuous power). In addition, particulars are given of 83 sites (1,102,070 kW) of which detailed examination is desirable. There are 228 entries relating to areas and rivers not yet examined, and some 69 sites are definitely written off as useless for reasons stated. It is no mean achievement to have collected these data and to have published them in readable and well-ordered form, and we emphasise the achievement the more because the Government of India decided in October, 1920—as a consequence of the Reforms—that all outlay on water storage and water power must be a Provincial charge. This means that the funds for hydro-electric surveys must be voted from Provincial estimates, and in a good many instances reductions have been moved. It would be a thousand pities were the completion of the Survey to be retarded by this cause. Early completion of the Survey is of the utmost importance to the industrial future of India and so to British manufacturers, who stand to gain large orders for the plant and machinery required for this development. During the cold weather of 1920-21 technical representatives of a number of large firms interested in plant for hydro-electric developments visited India as a direct result of the first two Annual Reports of the Survey.

Minimum and Maximum Power Development.

Even after three years of organised investigation it is impossible to do more than estimate approximately the total water-power resources of India and, before giving the principal conclusions reached, it is necessary to define the basis upon which the power is reckoned. The discontinuous power of individual sources, which may be available for six to eight months in the year, is always much greater than the continuous power available on minimum flow in the worst years. Particularly is this so in India, where the wet season is confined to a few months and the excess of power available during the time that the effect of the monsoon is still felt is beyond calculation.

The Dominion Water Power Branch of Canada finds that the "power for maximum development," dependable for six months, is nearly double that obtainable on "ordinary minimum flow," the latter being defined as based on the averages of the minimum flow for the two lowest consecutive seven-day periods in each year over the period for which records are available. The estimated flow for "maximum development" is based upon the lowest seven-days' flow in the lowest-flow month of the high-flow half of the year. It is conservative to assume that in India the continuous power on "ordinary minimum flow," as defined above, is 50 per cent. higher than the continuous power on absolute minimum flow, except in the case of Bombay and the Central Provinces. These two areas depend almost entirely on monsoon storage, and an addition of 20 per cent. is nearer the mark. Again, excluding these two areas, the power for maximum development is about three times the continuous power on absolute minimum flow; for the excluded areas, to allow for projects not based on storage, 60 per cent. is added for Bombay and 30 per cent. for the Central Provinces.

On these bases, taking round figures in each case, the probable minimum continuous water power in India is increased from 5,582,000 kW on absolute minimum flow, to 7,532,000 kW on ordinary minimum flow, and to 12,680,000 kW as the probable power for maximum development. The corresponding estimates for each of the main areas are shown in Table I. The figures are believed to be conservative estimates so far as concerns investigated sites; there doubtless remain many other unknown sites and the possibilities of development by "lifting dam" offer an untold number of sites in the smaller categories. The estimated power for the N.W. Frontier Province is quite tentative, and is not increased in the last two columns of Table I, because it is doubtful whether the Indus will ever be harnessed.

*Published by the Superintendent of Government Printing, Calcutta; 4 rupees. Obtainable from Constable & Co., London, and the usual agents for Government publications.

TABLE I.—Summary of Water Power in India.

Province or State.	Continuous power on basis of absolute minimum flow.						Probable total continuous power on "ordinary minimum flow," kW.	Probable total power for maximum development, kW.
	Water power now developed (site capacity) kW.	Plant under construction, kW.	Areas investigated, but not developed, kW.	Known sites worth investigation, kW.	Areas and sites not investigated, kW.	Probable total kW.		
Assam	—	—	109,000	5,000	300,000	**414,000**	**621,000**	**1,200,000**
Bengal	600	—	14,250	5,000	650,000	**669,850**	**1,000,000**	**1,500,000**
Bihar and Orissa	—	—	12,550	20,000	30,000	**62,550**	**95,000**	**150,000**
Bombay	71,400	50,000	272,560	230,350	20,000	**644,310**	**773,000**	**1,000,000**
Burma	3,370	—	155,800	492,400	300,000	**951,570**	**1,327,000**	**3,000,000**
Central Provinces ...	—	—	13,700	113,860	10,000	**137,560**	**165,000**	**180,000**
Jammu and Kashmir ...	105,830	—	—	179,500	20,000	**305,330**	**458,000**	**650,000**
Madras	740	—	32,670	53,900	5,000 × x	**92,310**	**138,000**	**300,000**
N.W.F. Province	[250]	—	—	—	[1,000,000]	**[1,000,000]**	**[1,000,000]**	**[1,000,000]**
Punjab	1,880	—	129,270	Cols. 4 & 6	662,000	**793,150**	**1,190,000**	**2,400,000**
United Provinces	4,330	140	378,900	"	20,000	**403,370**	**605,000**	**1,000,000**
Other areas†	24,740	5,500	75,580	2,060	—	**107,880**	**160,000**	**300,000**
Total	213,140	55,640	1,194,280	1,102,070	3,017,000	**5,582,000**	**7,532,000**	**12,680,000**

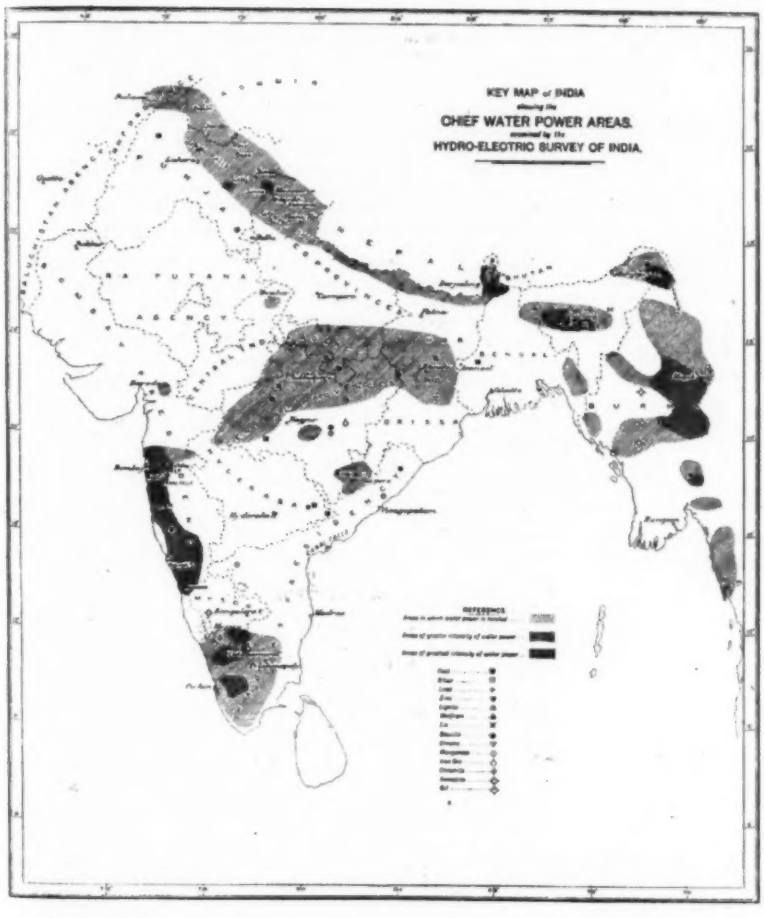
† Baroda, Central India, Cochin, Coorg, Gwalior, Mysore, Patiala, Rajputana, Sikkim, and Travancore; for details, see Report.

Plants in Operation or Under Construction.

It will be seen from the figures in Table I. that a very small proportion—only some 4.8 per cent.—of the probable total continuous water power of India (on absolute minimum flow) is represented by the site capacity of water power now developed (213,140 kW), and plants under construction (55,640 kW). At present there is 138,780 kW installed at the 22 sites developed; of this total there is 102,600 kW in Bombay (50,000 kVA each at the Andhra Valley and Tata Power Works), and 16,900 kW in Mysore at the Cauvery Plant. On the Jhelum River (Jammu and Kashmir H.E. Works, there is an ultimate capacity of 105,000 kW continuous power on minimum flow, but only 4,000 kW is at present installed. Plant totalling 112,950 kW is to be installed in five projects now under construction; of these the largest is the 105,000 kW Nila-Mula scheme, which will ultimately be tied in with the Andhra and Tata systems for the further supply of the Bombay industrial area.

Known Sites Awaiting Development.

Other useful information concerning the water power developed and the plants under construction is to be found in Mr. Meares's report, but we propose to devote the limited space at our disposal to the categories of known sites not yet developed, particularly those which have now been investigated by the officers of the Survey. The latter group offers



a probable (absolute) minimum continuous water power of 1,194,280 kW, to which may be added another 1,102,070 kW from the known sites worth detailed investigation. The following summary shows the order of magnitude of the projects suggested or known in these groups:—

Minimum power available, kW.	Number of sites investigated.	Known, but not fully examined.
Over 100,000	1	3
50—100,000	1	2
20—50,000	6	5
10—20,000	6	14
5—10,000	9	10
1,000—5,000	29	29
Total	52	63

From Table I it appears that the Provinces or States of principal interest from the point of view of water power are Assam, Bengal, Bombay, Burma, Central Provinces and Berar, Jammu and Kashmir, Punjab and canals, and the United Provinces and canals. The accompanying map shows the chief water power areas as disclosed by the Survey to date. In studying this map the location of present and potential industrial areas should be borne in mind, as well as the location of mineral deposits (as shown on the map). For various reasons it has not yet been possible to make much progress with the survey in Bengal and the Punjab, in both of which districts the water power potentialities are great.

The Principal Prospective Schemes.

Assam.—In Assam the Hukong Valley project is by far the best examined, offering, as it does, some 68,000 kW continuous power with a very cheap development. There are a number of smaller promising schemes which have been investigated and, from 17 entries relating to sites not yet examined, it is probable that another 300,000 kW could be developed continuously if required.

Bengal.—The only sites yet examined definitely in Bengal are in the Duars tea planting districts in the Jaldaka and neighbouring streams. The possibility of development here turns almost entirely on the question of "firing" (drying) tea electrically, and it is interesting to note that a good case can be made for the electrical method, the energy consumption being about 60 kWh per 100 lb. of tea made, compared with 36 lb. of coal (9,000 B.th.u. per lb.) per 100 lb. of tea delivered by a coal-fired machine. The Juldaka scheme, with a minimum constant flow of 189 cusecs and 1,000 ft. head, would yield 12,500 kW minimum continuous power. For the most part Bengal consists of the alluvial delta of the Ganges, and is practically at sea-level. Probably the Tista and its tributaries could be harnessed to give 500,000 kW in the aggregate, but the availability of suitable sites for development has yet to be investigated, and there then remains the problem of developing the sites in competition with Bengal coal.

Bombay.—It is a matter for regret that all work on the Survey has now been stopped in Bombay, and we trust that this policy may soon be reversed. Over a quarter of a million kilowatts has been located in sites investigated, and there is at least as much more in sites worth detailed examination. The Koyna project, estimated to yield 225,000 kW continuous power, is considered to be by far the most promising of all the possible ones in Bombay, and is among the largest continuous power sites in the world. It is a storage scheme with a catchment area of 346 square miles in the Western Ghats. The mean rainfall is 150 in., and, by tunnelling through the watershed a head of 1,600 ft. would be obtained. Messrs. Tata, Sons & Co. have applied for a grant to develop this project.

Burma is a wild and fever-stricken country with bad communications, but hydro-electric power is an economic necessity, due to the dearth of good coal, and it is probable that there is more available water power than in any other province. Most of the Burma schemes can be developed on flow alone. The yield from eleven rivers examined is estimated to be 155,800 kW, and from sixteen other rivers, not yet investigated in detail, 492,400 kW. In addition, there are hundreds of other possible sites concerning which little is known, but which undoubtedly bring the total water-power resources of Burma up to 1,000,000 kW (continuous). Three sites examined on the Nam Pang river represent 45,000 kW; one of many sites on the Nam Tu would yield 29,000 kW, and the Panlaung and Yunzalin rivers would yield about 25,000 kW each. The Irrawaddy is said to represent about 50,000 kW continuous power, but it is doubtful whether this immense river could be developed economically. By flood regulation and lifting dams the Salween could be made to yield at least 120,000 kW, whilst the Shweli (tributary of the Irrawaddy) is probably capable of developing 250,000 kW or more.

Central Provinces.—After the figures given in the preceding paragraph the 13,700 kW available at the Silewani Ghat monsoon storage scheme (Central Provinces) comes rather as an anti-climax. Nor is there any much larger project among the seventeen known sites in the Provinces, which nevertheless represent the respectable total of 113,860 kW, and include at least three schemes (13,000 kW) which would be cheap to develop.

Jammu and Kashmir.—Although not in British India, the Chenab River project would probably find its outlet for the sale of power in the Punjab; about 29,000 kW could be developed continuously at a great bend in the river a few miles north of Riazi. Particulars are given in the Report concern-

ing a tunnel site on the Jhelum River near Muzaffarabad. This site, which is one of the finest in the whole of (geographical) India, is in Kashmir, but is unlikely to be developed for Kashmir needs. Under the scheme recommended a minimum output of 150,000 kW could be developed continuously, the transmission lines would be entirely in British India, and this project, interlinked with those of the Sutlej and the Jumna, would provide power for the whole area bordering on the Himalayas for some time to come.

Punjab.—The Punjab has enormous potential power throughout the whole Himalayan area, but so far attention has been devoted mainly to the Sutlej River project and the subsidiary Anu and Nangal projects, representing in all 89,270 kW minimum continuous power. In addition, 68 falls on the canals would provide about 91,200 kW on normal discharge or, say, 40,000 kW on minimum flow. When more power is required in the province it can be obtained from some of the 30 sites on the Punjab rivers, which are estimated to be capable of yielding 662,000 kW continuous power.

United Provinces.—Of the 28 sites examined in the United Provinces, representing about 370,000 kW continuous power on minimum flow, a multiple flow and lifting dam scheme for the Ganges and its tributaries accounts for 140,000 kW, but the practicability of this project is dependent upon flood regulation. So also is a 65,000-kW project of the same general type on the Pindar River. From two sites on the Ken River, which, incidentally, would benefit irrigation, at least 32,000 kW could be developed, and far more if an upper site were developed. Project estimates are in preparation for the 11,000-kW Beehar River project, the site of which is 130 miles from the great industrial area of Cawnpore and 60 miles from Allahabad. Estimates are also in preparation for the development of the noted falls on the Tons River. This fine project would yield 32,000 kW at a site within 130 miles of Cawnpore, assuming a constant flow of 1,440 cusecs and a head of 335 ft. (obtainable by an open channel). An ideal reservoir site has been surveyed a mile above the falls and the cost per million cu. ft. stored would be only about Rs. 183, which is exceptionally low.

Reasons for Rejecting Sites.—Sixty-nine sites in various provinces and states have been found to be useless for power purposes because the total run-off is insufficient in small catchments, because there are no storage sites adequate to carry over the dry season, or because the cost of development would be prohibitive. As fuel becomes scarcer and more costly it will pay to develop more costly sites, but no project has been condemned on the ground of excessive cost that is not clearly out of the question at present.

In the initial stages of the industrialisation of India cheap development of hydro-electric power—low total investment as well as low cost per kW—will naturally be a vital consideration, and it is probable that, in all parts of India, many of the smaller available projects will be the first to be developed. It is a primary function of the Survey to place on record all available information concerning all sites, so that the most economical scheme may be selected in each locality. This function is being discharged in a most admirable manner, and we commend the Report of the Survey to the attention of all readers interested more than superficially in Indian affairs. In the space at our disposal it has been impossible to do more than present some of the more striking facts from this masterly work, which is indeed a valuable addition to the literature on Imperial resources.

TELEPHONE LINE WORK IN THE UNITED STATES.

Discussion at Manchester.

When Mr. E. S. Byng read his paper on the above subject (which was abstracted in our issue of November 25th, 1921) at the North-Western Centre of the Institution of Electrical Engineers, Ald. W. Walker, chairman of the Centre, presided, and in the subsequent discussion

Mr. W. J. Medlyn pointed out that the foundation of any successful business undertaking was based on the financial studies of development schemes and, on general lines, the arrangements in operation in that respect in this country were in agreement with the practice which obtained in America, as described by the author. Electrolytic troubles were much more prevalent in America than in this country, and it was suggested that our advantage in that respect might be due to the Board of Trade regulations relating to power supply systems.

How could any real economy result from the use of untreated poles with a short life when, although timber was cheap in many localities, the labour cost of handling was high, and when a pole was renewed there was not only the cost of dealing with that particular item, but considerable extra expense in transferring the wires or cables which it supported? Maintenance charges for short-life plant would also be higher because of its greater liability to fail in stormy weather. As regarded the use of motor transport and machinery, it was always a question of balancing the comparative costs of labour and machinery, an excess of one or the other being uneconomical. The final test of overall costs was the price at which they could afford to sell their services to the public, and the evidence brought before the Select Committee on Telephones showed that in that respect the British Post Office compared not unfavourably with the rates charged in the United States when all the factors were fairly taken into account.

Mr. T. E. Herbert emphasised the difference in the climatic conditions so far as open-line construction was concerned. After all, the test of any system of construction was the annual charges which it involved. Perhaps the most noteworthy feature of American lines was the adoption of very short spans; it was probably to that that the overloaded aerial routes in America owed their immunity from destruction. But in this country, a short span reduced the dip and increased the rate of vibration of the wire. The result was that the wire was seriously chafed at the insulators, and when ice accumulations occurred, many of the wires broke in the short spans.

In this country glass insulators had never found favour. The arrangement by which two circuits were terminated in the two grooves of the insulator—for transposition or other purposes—would unquestionably lead to very serious trouble. His experience of aerial cables had been a disastrous one.

Mr. J. Shea was particularly interested in Mr. Byng's paper because he brought home the fact that this country could be too conservative as regarded methods of construction.

He had run single steel wire through for as many as seven spans and it made quite a good job at a low cost. It certainly was not necessary to terminate at every pole. He was a great believer in aerial-cable work and agreed in principle with the American practice. There was a distinct field for that class of work in this country. The National Telephone Co. used a good deal of rubber-covered and lead-covered cable, particularly where competition existed (at Glasgow, Portsmouth, Brighton, and other towns), and his experience was that lead-covered cable properly erected was a sound proposition. It was not faultless, but neither was an underground system. Vibration which caused cracks in the cable sheath was practically their only trouble, a problem not impossible of solution.

Mr. G. H. A. Wildgoose thought that lump sum payments for private easements would be convenient as, in addition to the advantages named in the paper, the consent, presumably, would not contain a three months' removal clause. Regarding the encouragement of the joint use of poles for telephone and electricity supply wires, the practice would scarcely seem in accord with the cry which had gone forth on both sides of the Atlantic: "Safety First."

Mr. G. Wallace pointed out that the concentration of all testing and localising apparatus, as adopted in Manhattan, would be quite unsuitable and uneconomical if adopted in other cities in the United States more closely akin to even the largest English exchange areas.

The principle of telephoning line faults to a central distribution centre had been in operation in Manchester for some years past, with very satisfactory results, but under present conditions it was more economical to do the preliminary testing at the relevant exchange.

Mr. A. F. White said if a comparison was made between the cost of jointing in this country with that obtaining in America, the slower rate of from 50 to 60 prs. per hour at a cost, say, 2s. was to be preferred to the American 150 prs. at a cost of 6s. Not only was the first cost as low, but the better workmanship obtained in this country would be a large factor in the cheapening of the maintenance charges during the life of the plant.

Mr. C. E. Morgan had no doubt that the author had been shown a good deal of the best class work he was looking for, but was he shown the worst plant conditions? His paper did not describe average conditions.

There was certainly scope for aerial cables in this country, but only to a very limited extent, when it might prove to be economical. A feature of the American practice was the shortness of their aerial spans and the large spacing of 24 in. between the cross arms. Both of those items appeared to involve unnecessary expense. A cable with a lighter gauge conductor than the 64-lb. one extensively used in this country, could only be justified in the centre of densely telephoned cities where the duct capacity was of paramount importance.

Mr. E. S. Byng explained, in reply, that in this country labour was not as productive as it was before the war. Machinery was not affected in that way, and the Americans obtained their speeds by the use of machinery. The speed of working had no effect upon the health of the men, because the men only worked a short day. Americans in case of a serious breakdown were willing to work any time, but under ordinary conditions they would not work overtime at all. Whilst working they really worked very hard, when they finished they played hard, and from the health point of view the Americans were better.

When electricity supply lines were carried on the same poles as telephone lines the maximum a.c. voltage allowed was 5,000 volts between one wire and another, or 2,000 between one wire and earth; with d.c. 750 volts was allowed. The power wires were always placed at least four feet above the telephone wires so that the telephone men never came into contact with the power wires; the power men had to go through

the telephone wires, but there was sufficient space left for them to do so. Nearly every residence had electric light and the supply was invariably taken overhead; therefore, unless they had some joint method there would be unsightly duplication of plant.

The Chairman, in dealing with the efficiency of American workmen, wondered to what extent that efficiency arose from the thorough educational processes they were put through in the schools, which seemed to be part of the organisation of the American companies. Had the English telephone system in connection with its organisation any equivalent to that method of training?

Discussion at Edinburgh.

At a fairly well attended meeting of the Scottish Local Centre of the Institution of Electrical Engineers, Mr. E. S. Byng's paper was read on March 14th, 1922. In opening the subsequent discussion, Mr. J. M. M. Munro stated that what surprised him most was the reported ease with which the multiple cables were pulled through the wire loops called "rings" hung from the steel strand for supporting the cables. The absence of wear, and of electrolytic action between the cable and rings, was also contrary to expectation.

Mr. C. Vernier, speaking of mechanical excavators, said that in Britain they were unsuitable even for narrow rural roads because the trenches were dug in grass margins close to hedge and fence lines. That was done usually for ease of digging, though with excavators the difficulty in that respect would not be great and the cable would be kept away from growing root tips. The high insulation test required in Britain on completed cables might not be necessary to maintain, but it was a useful measure of the care taken in design and erection.

Mr. R. Waring thought that it would appear that American engineers now went to a greater refinement than was usually considered necessary in this country. For example, it was stated that statistics regarding school enrolments, and birth and death rates were taken into account; further, that forecasts of telephone growth were made in relation to families rather than to population, as they were considered to afford a more reliable standard. In this country reliance had been placed on the class of property, *i.e.*, whether offices, shops, warehouses, or works, and in the case of residences, the character of the district and the rental value of the property. Past growth and the ratio of subscribers to population were considered to be very useful checks on the development forecast.

With regard to underground work, the author stated that electric lamps in conjunction with portable accumulators were used for the illumination of manholes. Did that refer to town or country? In some of the more important manholes, they had permanent lighting fixtures connected with the battery at the nearest exchange. One pair was taken out of a cable to one side of a wall plug, the other side of the latter being earthed; the pair was connected to the main 22 or 40-volt battery, as the case might be, through a suitable fuse. The jointers had a plug and metal-filament hand lamp. Normally the pair was disconnected at the exchange, the fuse being inserted at the jointer's request. The fitting used in the manhole was of a waterproof type.

The author's statement that glass insulators were now standard for all purposes appeared to have evoked some surprise in this country; glass insulators were tried in this country over fifty years ago and found wanting. It might be that improvements in manufacture had altered the position.

Mr. A. S. Hampton's opinion was that America must be a very much drier country than he had hitherto taken it to be. For instance, wooden pins for insulators could not be used in this country. In the storm which occurred on January 15th hundreds of ⅝-in. wrought-iron pins were bent and twisted into every conceivable shape. Had those pins been of wood, he did not know what would have happened. The erection of poles at the rate of 300 a day of eight hours, with eight men, was impossible in this country. Tractors could not work on railway banks in this country; railways were so very near the next man's field, and if they entered the field they would have all sorts of claims for damage. Tractors and machines for boring holes might be useful in this country for rural roads, but were of no use at all for railways. Glass insulators would not do in this country because the atmosphere was altogether too moist; America must be very much drier. He did not think a very large cable would stand in this country. It was quite apparent that our climatic conditions must be very much worse than they were in America. An ordinary 7½ or 400-lb. iron wire, during a snow storm, sometimes assumed a thickness of about five or six inches in diameter, and if a number of wires were carried on a pole, the pole was very liable to come down. Poles carrying a cable anything like the size of that described by Mr. Byng would undoubtedly break. It was quite impossible to put up such poles in this country; it might be possible in the South of England, but in Scotland no such practice could obtain.

ELECTRIC MOTOR STARTERS.

[*Abstracts of papers and discussions before the* Institution of Electrical Engineers.]

Electric Motor Starters.

By J. A. ANDERSON, M.I.E.E.

(*Concluded from page* 570.)

The standard formula for d.c. and balanced a.c. starters is applicable to a.c. unequally cut out, with certain reservations. The current-rush from notch to notch is of relatively small importance; it is important, of course, but the basis of the starter proportions must be the permissible out-of-balance current. There is no correct number of notches for alternating-current starters, but the greater the number the better the performance of the starter or controller.

A simple and original method of calculating the notches and sections for unbalanced resistances that was developed by the author's assistant, Mr. Fox, is explained, as is also the "eddy-current" rotor starter, which presents quite another series of problems. It consists of a choking coil wound on a solid iron core, and the starting torque is due mainly to the eddy-current and hysteresis losses in the iron at standstill. It is a very useful form for reversing rolling mills, but it would seem that a better result would be obtained by the use of a true auto-transformer, with more or less laminated cores, which would supply current at low voltages to a massive resistance element capable of being run at a high temperature, say 600 deg. F., without risk of damage to the windings; the auto-transformer could be designed for any convenient loss and the required torque obtained by adjusting the resistance.

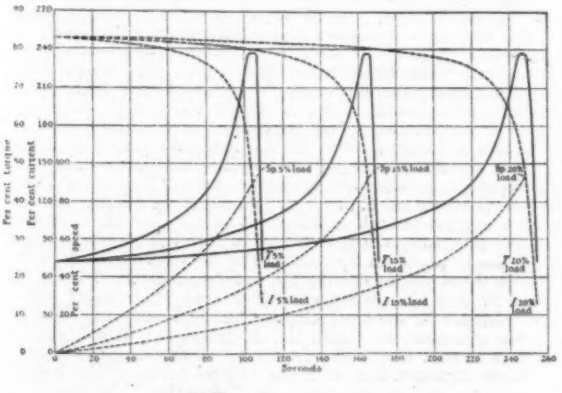


Fig. 5.

Rheostatic stator starter. Line resistance passing about 250 per cent. current. Drawn for a stored energy of 10,000 ft.-lb./b.h.p. At 20 per cent. friction load the average and r.m.s. currents are about 95 per cent. of initial current. Small kick on finally cutting out line resistance not shown.

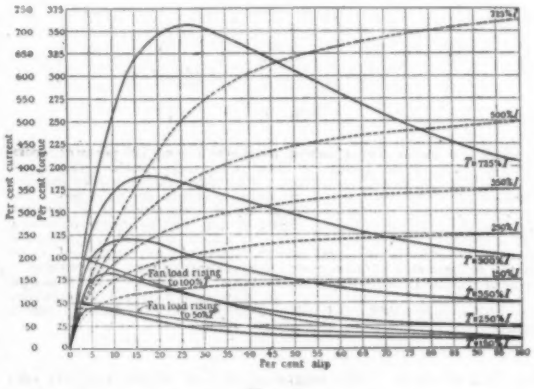


Fig. 6.

Rheostatic stator starter. Torque and current curves with various amounts of resistance in line. Dotted lines represent driving torques for fan loads.

An entirely different series of problems has to be considered when the resistance is inserted in the stator or when star-delta or auto-transformer starters are used, because the motor is starting from short-circuit conditions and, if the subject is to be dealt with thoroughly, it is necessary to have the performance curves. Even to-day the motor makers, with one or two exceptions, are so unwilling to supply these data that the suspicion arises that in many cases they do not possess them.

Fig. 5 is typical, and the current curve is square-shouldered instead of saw-toothed, and the torque curve bears no resemblance to the current curve.

Fig. 6 has been worked out for various amounts of line resistance and, if the load torque is known, the curve shows how much current must be passed on the first notch; how the motor torque and current vary while running up to speed; and if the load torque is laid off on the diagram as has been done for centrifugal fan or pump loads, it can be seen how many notches the starter should have.

Results of calculations worked out form figs. 5 and 6 are conveniently recorded as shown in fig. 7. the arrangement of which is due to Mr. Fox.

The auto-transformer curves also serve for star-delta and series-parallel starters because these act like an auto-transformer with one tap and without the voltage-drop in the transformer windings. The starter maker has, then, a means of tackling intelligently and quickly any starting problem.

The rating of rheostatic stator starters follows the general lines already described, but new problems arise in rating the auto-transformers. . The vast majority of auto-transformer jobs do not require more than 10 seconds per start. The only

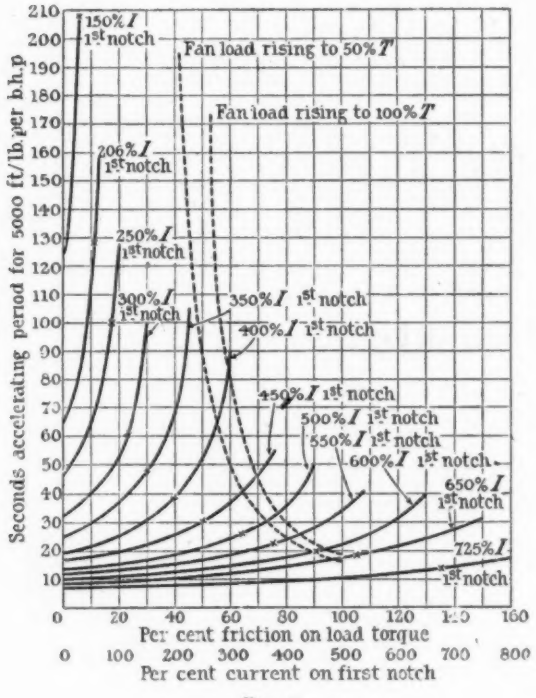

Seconds accelerating period for 5000 ft/lb per b.h.p
150% I 1st notch
Fan load rising to 50% I'
Fan load rising to 100% I'
206% I 1st notch
250% I 1st notch
300% I 1st notch
350% I 1st notch
400% I 1st notch
450% I 1st notch
500% I 1st notch
550% I 1st notch
600% I 1st notch
650% I 1st notch
725% I 1st notch
Per cent friction on load torque
Per cent current on first notch

Fig. 7.

Rheostatic stator starter curves, drawn for motor having 725 per cent. short-circuit current. Calculated for 5,000 ft.-lb./b.h.p. stored energy.

Use of full-line curves.—Crosses show points which should not be exceeded to allow of sufficient excess motor torque to overcome static friction. For example, constant load on friction torque during acceleration of 40 per cent. Cross on 400 per cent. current curve corresponds, so sure to start; accelerating time 38 seconds for 5,000 ft.-lb./b.h.p. and *pro rata* for other amounts of stored energy. Could use 350 per cent. current first notch, but balance of excess torque to overcome static friction very low; accelerating time 350 seconds.

Use of dotted-line curves.—These are for fan loads. For example, if passing 300 per cent. current first notch, with load rising to 100 per cent., accelerating time is 78.5 seconds. With load rising to 50 per cent., accelerating time is 50 seconds.

factor that matters is the temperature-rise of the copper, *i.e.*, the I^2R losses, and the iron has no time to heat. For short periods, *e.g.*, 10 to 30 seconds, the rating is based on the specific heat multiplied by the weight of copper; the true cooling is very poor and an auto-transformer is particularly unsuitable for continuous-cycle starting.

There is little advantage in oil immersion. The chief advantage of the oil is that it excludes moisture, prevents the cotton covering charring, and permits the use of a fairly high temperature-rise, say 150 deg. F., with perfect safety.

A point which requires consideration is the magnetising current; if the iron is cut down drastically this goes up and may become very important. The designer of an auto-transformer for starting purposes has to discard many of his pre-conceived notions acquired when dealing with transformers for continuous duty. One of these is regulation, which is determined by the temperature rise in the period. Apart from this it is of little consequence, because the function of an auto-transformer is to reduce the line current and the pressure at the motor terminals, and it matters little whether this is due purely to transformation or not.

Discussion at Birmingham.

Mr. J. Anderson's paper was read and discussed at the South-Midland Centre of the Institution of Electrical Engineers on March 15th.

Mr. W. Wilson thought the author deserved to be thanked for emphasising the importance of the design of the controlling apparatus in an electric system. The motor had apparently reached almost its final form, and it was chiefly on account of the important developments that were taking place in connection with the design of starting and controlling gear that the application of the electric motor was still extending rapidly. The uncertainty of the data on which the starter designer had to base his calculations usually led to very wide allowances being made in designing standard starters which were therefore considerably larger, contained a greater number of steps, and were much more costly than should be necessary. The important point to note was that unless the acceleration was either automatic or hand-performed in such a way that the speed was exactly right at every step, the results secured in practice would be very different from those given, for example, in any of Mr. Anderson's curves; a considerable improvement in that respect could be effected if starters were accompanied by an instruction that the correct method of operating the handle was to begin moving it slowly, and to increase the speed progressively as the final step was reached. Probably the number of steps could be halved if it were not for that uncertainty about the rate of acceleration. In contactor installations it was permissible to employ fewer steps, because the rate of acceleration could be closely governed, and therefore the allowance to provide for uncertainty in that respect was very much reduced. It would tend to a better result if far more attention were devoted to the starting load, even if the motor itself had to be partly ignored. When starting at no load a 5-h.p. shunt motor could be safely started with only two steps of resistance, the whole operation absorbing, say, two seconds. The usual standard starters required seven or eight steps, and the resistances were designed to be in circuit for anything up to one minute. The difference in the space taken up by the resistance units in the two cases could be easily imagined. With regard to the voltage and current-limiting systems for accelerating contactors, he was in agreement with Mr. Anderson as to the superiority of the latter. The weak point of the voltage method was that the resistance of the coil altered materially as it heated up, with the result that the accelerating points were radically altered if the machine had been in service for some little time.

Mr. W. J. Line explained, with regard to temperature tests on resistances for rating purposes, that for starting duties reliance could not be placed on thermometer tests owing to the poor thermal contact between the resistance wire and the thermometer bulb, and also the lag and reduction in readings due to the mass of the mercury relative to the adjoining resistance wire. More accurate results were obtained from the thermal capacity of the resistance material calculated from its mass and specific heat, with, if necessary, a few per cent. allowance for the heat dissipated during the start. Regarding out of balance currents in three-phase rotors, the author's table 4 showed some remarkable figures, especially when the rotor was running practically single phase. Under such conditions a machine could only run nearly light, and would neither start nor accelerate on anything near full-load torque, but would fall out of step. He did not agree that the currents in the stator were really practically balanced. They might appear so, because the frequency of the pulsations of the stator current was too high for the ammeter to follow, but actually the current in each supply line and phase of the rotor winding was pulsating, the current peaks and valleys circulating from phase to phase all the time. The fluctuations were, of course, not those due to cutting out resistance steps, it being understood that the phenomenon described would occur while the resistance in the rotor phases remained constant. The swinging of ammeters which Mr. Anderson mentioned was at any rate in part due to the frequency of the stator current pulsations corresponding with the natural period of the instrument swing, causing resonance or "shunting" between instrument and pulsations, the swing being thereby amplified. The excessive stator currents mentioned were due to the fact that the unbalanced rotor conditions almost totally destroyed the motor torque, and then the motor, in the endeavour to cope with the load, took an excessive stator current.

Dr. Kahn pointed out that the starting process, as shown in the diagrams, could only be realised in actual practice if the operator had an indication when the starter handle should be moved; that could easily be provided by a rough current indicator marked with red lines to show the limits or the stepping of the current. Such an instrument need only consist of a current coil with a movable iron core, a balancing

spring, and the indicating needle. As each starter had to be rated for a certain current, the instruments could be standardised and embodied in the starter case itself, making them an integral part of the starter. As the starter would have a chance to be used in a correct way, it could probably be made with less steps if fitted with an indicator, and the saving would presumably pay for the indicator. As long as the current taken depended almost entirely on the operator, who had little indication whether he was using the apparatus correctly, a large safety factor was necessary, which explained the low temperature rise allowed at present. He agreed with Mr. Anderson's remarks on the eddy-current starter, especially his criticism of the arrangement of insulated windings on the iron core. The arrangement proposed by the author was equivalent to the eddy-current starter and had the same disadvantage, that the rotor current flowed through a circuit of high reactance at the beginning and during the major part of the starting period. That could be avoided by adopting instead a rheostat and a choking coil with laminated core in parallel, thus connecting the high resistance and the reactance in parallel, instead of in series as in the two methods just mentioned. The choking coil could then be so dimensioned that it would take a comparatively small current during the first part of the starting period, the bulk of the current flowing through the resistance.

Mr. A. T. Bartlett was surprised that there was little or no reference to the effect of thermo-capacity in connection with the resistance material or units. That, of course, had a large influence on the rating. Regarding the remark that corrugations on transformer tanks and the ribs on small internal-combustion engines were practically useless, as the oil-tank experiments did not appear to have been made until a uniform steady temperature had been reached, such a deduction was not justified, though no doubt the use of corrugation and ribs had been considerably over-rated.

Mr. A. E. Angold thought that many of the author's difficulties arose from attempting to measure temperature rise by thermometers. All the electrical, also the heating and cooling characteristics of a line of auto-transformer starters, whether air or oil-cooled, could be expressed as powers or roots of their lineal dimensions. Temperature tests calculated on the rise of resistance of the copper were practical, and it was the temperature of the copper in contact with the cotton and oil which limited the duty of any such starter. In the same way the temperature of the wire of a resistance starter limited its duty, so that if they had a reliable method of measuring the temperature of the wire they could hope to set out the desired formula for rating. To determine ratings for intermittent use, temperature must be calculated from the rise of resistance. One way to do so on open spirals was to substitute an iron wire of the same gauge and maintain the correct wattage on the spiral. Accurate calculation, from current and voltage readings, of the temperature rise on any part of the spiral could then be made.

Mr. R. G. Jakeman said that the author did not mention the case of a mine-ventilating fan with long air-passages. If the fan was brought up to speed quickly it would be running at full speed before the air-pressure had risen to its full value, with the result that the motor would be seriously overloaded. The motor must, therefore, be accelerated slowly and the starter rated accordingly. The same remarks applied to a centrifugal pump, if it started with the delivery pipe empty. In asking for particulars of the armature resistance from the motor makers, it was necessary also to obtain the resistances of the interpole and compensating windings. The author stated that the resistance drop in an auto-transformer starter was of little consequence, but the greater the resistance the higher the current taken from the line for a given torque. With a rheostatic starter, if 50 per cent. current was required in the motor, the same current must be taken from the line, whilst with a pure auto-transformer starter only 25 per cent. was taken from the line. The use of unequal tappings on the phases of an auto-transformer did not appear to be necessary, since such fine adjustment was seldom required.

Mr. J. Anderson, in reply, said they did use smaller ratios for the early notches as a matter of course when the power to be broken at the notch exceeded the breaking capacity; extra notches were introduced to decrease the arcing. Intermittent ratings could be calculated, but it was not so easy as it seemed. Referring to Table 4, the swinging noted was not due to synchronism of the current frequency and natural periodic time of the instrument movement because currents at least equal, at the peaks, to 200 per cent. current actually flowed, although the motor was on light load. Thermal storage on short ratings was advantageous, and very high capacities could be obtained, but it was difficult to make connections in a satisfactory manner. The statement regarding the effect of resistance in the auto-transformer windings was only intended to apply within certain limits, and should not be pushed too far. Regarding out-of-balance with closed and open delta auto-transformers, he preferred to use three-limb star-connected transformers to avoid out-of-balance effects, although it made the switchgear more expensive. The method of dealing with out-of-balance currents in the appendix was due to Mr. Fox. Measurement of temperature by thermometer was standard and preferred by the B.E.S.A., and as all tests were continued for many hours there was no doubt that the thermometers gave sufficiently accurate results.

MICA RESEARCH.

The investigation into the properties and uses of mica, commenced by the Institution of Electrical Engineers, and now under the direction of the Electrical Research Association, has not yet been completed, but a report embodying some important results has been issued.

A difficulty was met with when classification came to be considered, owing to the lack of uniformity in trade names. A schedule (A) has therefore been prepared in which the principle varieties are classified together with their mineralogical group, general characteristics, and relative hardness. The two standards of comparison are: hard, ruby mica; and soft, amber mica. A collection of representative micas, supplied by Messrs. F. Wiggins & Sons, and Messrs. Startin and Co., has been presented to the I.E.E.

It was found that very little previous work had been done in this direction and that small regard had been paid to the selection of the proper variety for a particular purpose. Owing to the absence of data, specifications for mica usually have recourse to the requirement that "only the best clear ruby mica shall be used." In view of this it has been found impossible to define with precision test clauses suitable for a general mica specification, and attention has been confined to specifying the principal uses and the characteristics necessary. Schedule B is a list of identification tests for micas; these consist of observations upon the calcination temperature; colour characteristics; nature of surface; optical effects, such as the percentage absorption of light; nature of surface after acid treatment; and the dielectric constant and losses. Schedule C specifies the type of mica to be used for various purposes. The main headings of this schedule are "Commutators," "Wrappings, Channels, Tubes, and Washers," "Condensers," "High Temperature Purposes," and "Mechanical and Optical." Mica for commutators has received special attention and opinions have been obtained from leading manufacturers and carefully sifted. The pure mica used for commutators is usually stained and spotted, brown and green, light and dark in colour. Separators in one length are obtainable up to about 16 in. or more, but when the length exceeds 6 in. it is more economical in cost to use built-up material or micanite. In the smaller sizes pure mica is cheaper. It is questionable if built-up mica is better than micanite, specially made, for commutator separators, owing to the amount of adhesive required. Micanite separators should not contain more than 2 or 3 per cent. of adhesive; ordinary micanite may contain from 10 to 15 per cent. There is no reason why micanite for separators should not be made from spotted and stained mica, as the price of clear mica is 100 per cent. more than that of spotted, and about 25 per cent. more than the price of stained mica. Some makers undercut all commutators, but flush segments are still largely employed, especially on small machines, where hard brushes are used. Commutation on most modern machines is so good that the machine may run for years on the first undercut. On important machines, however, where soft brushes are generally to be found, some makers use soft separators, and are willing to pay the extra cost of amber mica. Further research is in hand on the abrasive hardness of mica in order to determine what micas will give satisfaction with flush separators.

The following conclusions have been arrived at: All three kinds of separators can be obtained finished to a sufficient degree of accuracy for the purpose. In general + or − one mil can be guaranteed without difficulty on mica segments, and + or − two mils on built-up mica and micanite; the last can also be brought under a guarantee of + or − one mil. Pure mica makes the best mechanical job, and is less likely to flake or change under the influence of heat. Micanite properly compressed, and with a minimum of adhesive is successfully and extensively employed in both large and small machines. It is cheaper, except in small sizes, and is less liable to give trouble through hardness or hard spots. Difficulty has been experienced where oil has got on to the micanite, as the oil and adhesive together become carbonised, necessitating the dismantling of the commutator to remedy the trouble. This also applies to built-up mica.

Rings are sometimes made up of the more flexible grades of mica butt- or lap-jointed, but micanite is usually employed, the cones being built up from suitably cut pieces stuck together and pressed into shape while hot. The adhesive left in may be of the order of 10 per cent.

The splitting of Indian mica is more cheaply done by Indian labour, before shipment to Europe. It is a trade developed solely for the electrical industry, and the tendency of the individual buyer to purchase very cautiously material in the production of which he has no control and imperfect information, has resulted in the supply consisting almost exclusively of clear mica, whereas, for many purposes, stained spotted, and dark-coloured material could be used with considerable economy in first cost.

The Association is not prepared to make definite recommendations until information is available on the nature and incidence of inclusions and impurities in mica from the electrical standpoint, showing their effect as conductors on breakdown voltage, surface leakage, and dielectric losses. Research on this is to be put in hand.

FULLER "SPARTA" ACCUMULATORS.

In the manufacture of "Sparta" batteries of accumulators for motor-car starting and lighting purposes, Fuller's United Electric Works, Ltd., have the advantage of being experts in the production of ebonite articles, and it is, therefore, not surprising that this material figures very prominently in the firm's batteries.

The method of making the "Fuller" cell container is said to be unique, the material being worked up in several plies so that the risk of a defect in any one ply becoming ultimately responsible for a leak, is eliminated. In addition, the bottoms are constructed in a novel manner which renders them continuous with the walls, and prevents leaky bottom joints.

Two types of ebonite lid have been developed: One is the well-known recessed type, in which the floor of the lid lies about ¼-in. below the level of the sealing compound and forms a well in which any acid spilt or escaping is trapped, so as to prevent it reaching the walls of the wood box or the floor of the battery carrier. The acid level is maintained at a very short distance below the under-surface of the lid, and the vent is fixed in a central dome. By this means, splashing is prevented by throttling the waves before they can properly form, and only a very simple vent is needed to allow for the escape of gas without risk of acid being splashed through it.

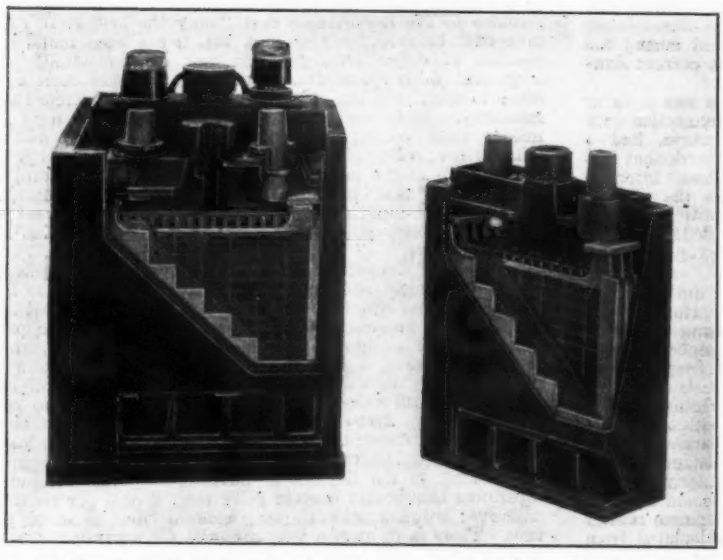


Fig. 1.—"Sparta" Motor-car Starting and Lighting Battery.

For batteries which are mounted in an exposed position on the car, another type of lid has been developed, which is domed so as to leave a considerable air space above the acid. To prevent splashing in this case, a very simple and ingenious vent is employed: A tube extends from the lid to just below the acid level and has one or more vertical slots throughout its length; a simple screw-down vent carries another tube, which lies centrally in the one previously mentioned, and has also a vertical slot. The slotted tubes form a complete carrier path that is said to prevent any wave from reaching the outside and, at the same time, the slotted construction is such as to avoid the usual defect with vents containing small holes—namely, the formation of bubbles by the escaping gas blowing up acid which is bound to lodge in such holes.

The terminals in the domed lid are secured by a new device that consists of small screwed ebonite collets, which tighten on to a rubber gland collar on the terminal. The collets are very easily removed without damaging the lid and have the advantage that they can be removed as often as desired, as the material of the thread is ebonite and not merely antimonial lead.

A further interesting use of ebonite in the "Sparta" battery is that of the end shields or "U" pieces, which are light pieces of ebonite of channel section, which completely shroud the sharp edges of the positive plates. It is at this point that nearly all the short circuits, due to the tendency of plates to buckle, are caused, and by employing this method of protection the Fuller Co. is enabled to take advantage of the low resistance and fine separation afforded by corrugated-wood separators without the usual risks attendant on this type of separator.

The above patented features will give an idea of the advantages of a close union between the experience of practical ebonite and accumulator makers combined in the one firm and in one factory.

The materials employed in making the Fuller negative plates expand when in use, instead of contracting as is the case with the ordinary litharge plate, and do not lose capacity as the latter do on account of their increase in density. For the first part of its life, therefore, the negative plate steadily increases in capacity until it reaches a point, after which the capacity is constant and further expansion does not take place. It is these little niceties in construction and composition which we had an opportunity of appreciating on the occasion of a recent visit to Chadwell Heath, which make all the difference between two batteries which are, in appearance, practically the same. For motor-car starting and lighting work, three sizes of plates are made—namely, the "Sparta," the "Over-size Spart," and the "Super-Sparta," which correspond with the sizes commonly employed by American motor-car makers.

Thirteen thousand wood separators can be turned out by a single machine per day. After the veneers have been suitably grooved for the work they have to do, they go through a complicated treatment which removes the whole of the resins and other harmful compounds, leaving behind the pure wood fibre, and the treatment is such that no reduction in the strength of the fibre is caused by it. The timber employed is specially imported and possesses a wonderfully straight grain, the finding of even the smallest knot or flaw in many thousands of separators being very rare.

An interesting development is the production of dry charged batteries which will give over 75 per cent. of their capacity immediately after being filled with acid. This can be done whenever required, and although not largely resorted to in the case of starting batteries, is a normal process in connection with other types made in the firm's works.

The "Sparta" battery-plate grids are of what is known as the "basket" type, and are made by chill casting. The inter-cell connectors are also cast in a hollow channel form, the reason for this being another of those small details which all add their quota to the high efficiency of the product. When we mention that a 71-amp.-hour battery supplied for one of the most popular makes of car has often to deliver as much as 250 amps. for a short period when the starting switch is closed, it will be realised that the heating of inter-cell connectors is a feature that is worthy of consideration. The shape of connector chosen, while containing the necessary amount of metal to carry such currents as we have mentioned, must be one that possesses the greatest possible amount of cooling surface. Special methods are adopted for sealing in the battery so as to overcome the twin difficulties which beset all sealing compounds—namely, the danger of becoming semi-fluid in hot climates, and that of drying off and cracking at normal temperatures. The sealing is performed in two operations; the first deposits a high-melting-point sealing compound, which would tend to be brittle and

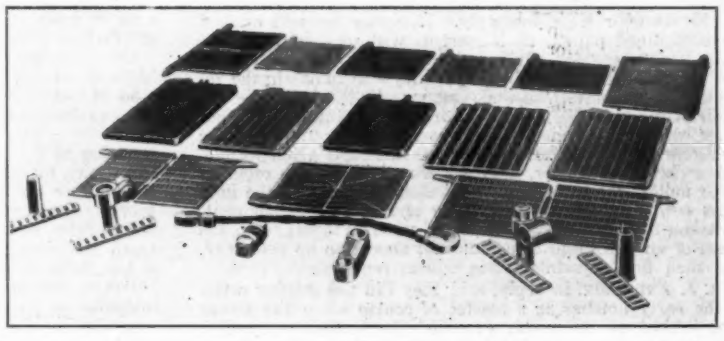


Fig. 2.—Fuller Battery Plates.

to develop cracks if employed throughout; then, over the former, a thinner and more plastic compound is poured, the result being an equal freedom from surface cracking and from troubles which arise when the sealing compound becomes plastic at high temperatures and tends to find its way past the lid into the cell.

Battery boxes are made of various woods, chiefly of teak and cypress, the latter being employed for "Sparta" batteries. The reason for the selection of these woods is their oily nature, which renders them far more immune from the attack of acid than are woods of a drier nature. "Sparta" boxes have combed and dowelled joints, and the handles are drilled into the sides and pinned by steel pins in position, thus preventing any risk of loose handles and providing an attachment which takes up no extra room in the battery box.

The paint used to cover the boxes is not a spirit paint, which is said to dry too rapidly to have a chance of thoroughly impregnating the surface of the wood. The boxes are *not* brushed, but are actually *soaked* in a tank of paint, being afterwards allowed to drain and dry; by this means, the penetration of all joints and crannies is ensured and the boxes are rendered more resistant to the acid than if they were merely brushed over with a quick-drying spirit varnish.

Even ebonite labels are used on the batteries, the instructions being moulded legibly on the face of the labels.

THE ELECTRICAL TRADES BENEVOLENT INSTITUTION.

On Monday last the annual general meeting of the Electrical Trades Benevolent Institution was held at the Institution of Electrical Engineers, the president of which, Mr. J. S. Highfield, occupied the chair.

The annual report of the Committee of Management stated that the number of members and subscribers for the year 1921 was 656, an increase of 350 over the previous year. The total income from contributions for the year was £2,191, making, with the receipts from dividends and other sources, a total income of £2,907. The result of the year's work was that an amount of £2,514 was carried to capital account, after the payment of grants and expenses. The sum of £3,707 was invested, making the total amount of invested funds at cost £18,063.

The number of applicants for assistance was less than anticipated, but the amount given was more than double that of the previous year. Every qualified applicant received assistance.

The work of the Local Advisory Committees was reflected in the increased membership and in the collectors' returns; in both of these respects great advances had been made, due to the activities of these committees. It was hoped that many more such committees would be formed in various towns, but owing to the trade depression it had been difficult to make progress during the past year. The number of members at the end of 1921 was 354, compared with 249 at the end of 1920.

The Committee again appealed to the heads of firms to assist the Institution by appointing collectors amongst the members of their staffs, and also by encouraging members of the staff to become members of the E.T.B.I., and thereby to qualify themselves and their dependents to become eligible for pensions should circumstances render this necessary.

The Annual Festival was held on October 26th, 1921, and was presided over by Sir T. O. Callender, J.P. The president's appeal resulted in a collection of £1,442. The dinner was the first of the Festival dinners of the Institution at which ladies were present. The vice-presidents were Sir William Noble and Mr. L. B. Atkinson, who ably supported the president in his appeal made at the dinner, which met with a generous response.

The Committee again drew attention to the advantages of membership, which were summarised as follows:—

"(*a*) Provision for Oneself.—There will be an ever-increasing number of persons in this walk of life who, through ill-health or other misfortune, unexpectedly find themselves in a destitute position. Seeing that there is now more than £10,000 invested, a member (or a member's widow or dependents) brought to such an unfortunate position is assured of the ability of the Institution to give adequate assistance.

"(*b*) Help for Others.—By becoming a member you assist towards giving temporary financial assistance to many who either are not qualified for pensions or only require some financial assistance to tide over difficulties.

"Membership carries with it voting powers, to be exercised when any application is made for a pension.

"The subscription of members is 10s. per annum, or such larger amount as each member is willing to give, and it may be paid in instalments."

Moving the adoption of the report and accounts, Mr. Highfield expressed his pleasure at being invited to preside at the meeting, because he was president of the Benevolent Fund of the Institution of Electrical Engineers, and his presence in the chair emphasised the fact that the two benevolent funds kept closely in touch with one another, and that there was no overlapping of their operations; each had its own sphere, and the Electrical Trades Benevolent Institution existed for the purpose of assisting persons who were not members of the I.E.E.

The income for the year was £2,907, compared with £2,333 in 1920; members' subscriptions amounted to £227, compared with £198 in 1920, and what was still more satisfactory, the number of ordinary members had increased from 156 to 249, and life members from 93 to 104. Dividends received amounted to £715, compared with £613. The total expenditure amounted to £281, compared with £275, the increase being due to the very considerable increase in correspondence entailed by the larger membership and the activities of the local advisory committees. The number of grants made was the greatest since 1915. The amount carried to the balance-sheet was £2,514, compared with £2,000 in the previous year.

Mr. J. Y. Fletcher, chairman of the Committee, seconded the motion, which was unanimously adopted.

The following members of the Committee retired by rotation, and, being eligible, were unanimously re-elected:—Messrs. R. W. Hughman, E. F. Johnson, Lt.-Col. H. M. Leaf, Messrs. P. A. Lundberg, W. C. Mountain, F. H. Nalder, W. R. Rawlings, A. A. Campbell-Swinton, and L. G. Tate.

The resignation of Mr. F. W. Fifield was accepted with regret. Messrs. Price, Waterhouse & Co. were re-elected hon. auditors, and votes of thanks were accorded to them, to the hon. solicitors (Messrs. Sugden & Hextall), to the hon. secretary (Mr. F. B. O. Hawes), and to the electrical Press, as well as to the Institution of Electrical Engineers, and to the chairman, Mr. Highfield, for presiding at the meeting.

LEGAL.

Charge of Fraudulently Obtaining Electricity.

On April 21st Gideon George Grieve and Archibald A. Manges, carrying on business as electrical and mechanical engineers at 14, West Bute Street, Cardiff, appeared at Cardiff police court, summoned on five counts for laying an electric wire to the Corporation supply so as to obtain electricity without its passing through the meter; and for culpable negligence and wilfully injuring the fittings and using the electricity without the consent of the electricity undertakers.

Mr. Kenvyn Rees, on behalf of the Corporation, stated that when defendants went into occupation at West Bute Street they made application for a meter to be installed. There was a meter on the premises, and this was connected up and the various fittings and fuses sealed up. For the first reading up to December 3rd they used 15 units; until January 15th the meter recorded 64 units; but on February 13th the meter recorded nothing. It was then found that the meter had been burnt out. The seals on the Corporation fuses had been broken and a fuse capable of carrying a higher current of electricity had been substituted. A wire had been connected by which electricity could be consumed without passing through the meter. By another wire defendants could get electricity for heating purposes. The men sold electrical heating apparatus, and it was assumed that they had been demonstrating these goods to probable purchasers without paying for the energy.

F. G. Barnard, an electrical engineer employed by the Cardiff Corporation, said the reason the meter burnt out was because an overload of current had passed through it. If consumption had gone on at the same rate as before there would have been approximately £2 worth of electricity used. This was for lighting only, and did not include any current which might have been used for heating or any of the extra supply which burned the meter out. He said that the cost of replacing the meter would be £3 10s.

Defendants pleaded guilty to fraudulently and feloniously consuming the current, and on this count the Stipendiary magistrate, Sir Thomas Lewis, fined them £50 each, or three months' imprisonment, and ordered the withdrawal of the other charges.

Damage to Feeder Box.

At the Marylebone Police Court, on April 20th, Geoffrey William Holt, an officer in the Royal Artillery, was prosecuted for being drunk while in charge of a motor car, and driving to the public danger. A police constable stated that defendant ran against another car and then drove into a feeder box, knocking it over and causing trouble at the power station. Mr. D'Eyncourt imposed a fine of £15, and suspended the defendant's licence for six months for dangerous driving, but dismissed the charge of drunkenness.

Marconi's Wireless Telegraph Co., Ltd., v. Hamilton.

In the Court of Appeal this interlocutory appeal by the defendant, who it will be remembered was a former employé of the plaintiffs, from an order of Mr. Justice P. O. Lawrence, was dismissed on Tuesday.

NEW PATENTS APPLIED FOR, 1922.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

10,016. "Battery ignition devices for internal-combustion engines." R. Bosch Akt. Ges. April 8th. (Germany, May 17th, 1921.)
10,028. "Apparatus for recording telephonic conversation." O. Zinke. April 8th.
10,031. "Dimmer-switches for motor vehicle lamps." N. L. Penn and Stamping and Spinning Works, Ltd. April 8th
10,043. "Electric switches." J. Hampson and R. Olsen. April 8th.
10,058. "Multiplex telegraphy." F. E. Pernot and L. J. Rich. April 8th.
10,076. "Apparatus for starting low-powered electric motors." A. Mélotte. April 8th.
10,084. "Electric condensers." W. J. Cole and Telegraph Condenser Co., Ltd. April 8th.
10,088. "Telephone systems." H. S. Conrad. April 8th.
10,089. "Apparatus for use in automatic telephone, &c., systems." H. S. Conrad. April 8th.
10,090. "Telephone switching, &c., mechanism." H. S. Conrad. April 8th.
10,091. "Telephone switching, &c., mechanism." H. S. Conrad. April 8th.
10,092. "Telephone systems." H. S. Conrad. April 8th.
10,093. "Telephone systems." H. S. Conrad. April 8th.
10,094. "Telephone systems." H. S. Conrad. April 8th.
10,115. "Dirigible head lamps for automobiles." A. R. Pellow. April 10th.
10,117. "Electric switch." A. C. Barton and F. H. Leffler. April 10th.
10,122. "Rheostat, &c." E. G. Craven. April 10th.
10,137. "Enclosed dynamo-electric machines." W. McGee & Son, Ltd., J. B. White and T. White. April 10th.
10,142. "Methods of locking electric incandescent lamps to holders." J. H. Reeves and J. Taylor. April 10th.
10,143. "Lifting magnets." H. R. Jones, W. E. Lawton, and C. E. Wood. April 10th.
10,144. "Lifting magnets." H. R. Jones, W. E. Lawton, and C. E. Wood. April 10th.
10,146. "Process of drying paper or fibrous insulated electric cables." F. Richardson. April 10th.
10,164. "Port lights." Steward Davit & Equipment Corporation. April 10th.
10,207. "Electric lamp fittings." British Thomson-Houston Co., Ltd., W. Milliner and H. C. Wheat. April 10th.
10,214. "Automatic, &c., telephone systems." B. B. Johnson and Relay Automatic Telephone Co., Ltd. April 10th.
10,215. "Long-distance telephone installations." Soc. d'Etudes pour Liaisons Téléphoniques et Télégraphiques a Longue Distance. April 10th. (France, July 8th, 1921.)
10,216. "Junction between electric circuits." Soc. d'Etudes pour Liaisons Téléphoniques et Télégraphiques a Longue Distance. April 10th. (France, June 20th, 1921.)
10,220. "Controlling mechanism of electrically-propelled vehicles." Mossay and Co., Ltd., P. A. H. Mossay, and Ransomes, Sims & Jefferies, Ltd. April 10th.
10,234. "Telephone systems." Siemens & Halske Akt. Ges. April 10th. (Germany, April 9th, 1921.)
10,231. "Spark plugs." W. H. Chard, O. S. Eastman, and W. F. Hills. April 10th.
10,234. "Electric recording and sounding device." W. H. Christie and F. N. Denison. April 10th.
10,243. "Electric locomotives, tramcars, road vehicles, &c." W. P. Durtnall. April 11th.
10,245. "Automatic switch." A. C. Barton and F. H. Leffler. April 11th.
10,246. "Electrically-heated treeing iron for boot, &c., manufacture." C. H. W. Brown. April 11th.
10,257. "Rotating contact switch for electric bayonet holder fitting." F. A. Milward. April 11th.
10,282. "Electrically-controlled indicating device." A. J. Gregory and J. Nicol. April 11th.
10,297. "Magnetic box." S. Orchard. April 11th.
10,300. "Alternating-current circuit models for educational purposes." J. K. Catterson-Smith. April 11th.
10,311. "Diaphragm for sound recording, reproducing telephonic, &c., instruments." M. A. Renison. April 11th.
10,343. "Damping device for switch contacts for electromagnetic vibrating members." A. H. Maitre and V. H. G. Martin. April 11th. (France, April 18th, 1921.)
10,348. "Prepayment meters for gas, water, electricity, &c." Landis and Gyr Akt. Ges. April 11th. (Switzerland, April 12th, 1921.)
10,371. "Storage batteries." Chloride Electrical Storage Co., Ltd. (W. E. Kershaw). April 11th.
10,373. "Electric brush holders, &c." A. Mélotte. April 11th.
10,382. "Charging electric accumulators." C. C. Garrard, M. J. Railing and W. Wilson. April 11th.
10,386. "Metal anodes for electro deposition." Scovill Manufacturing Co. (R. B. Ransford). April 11th.
10,393. "Regulators for electron discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.). April 11th.
10,397. "Means for connecting electrical conductors to sparking plugs." E. F. Wiederhoklt. April 11th.
10,402. "Holders and adapters for radio telephonic and telegraphic apparatus." G. B. Kersting. April 11th.
10,421. "Galvanic batteries." L. Fuller and Fuller's United Electric Works, Ltd. April 12th.
10,427. "Devices for application of electric power to agricultural machinery." J. A. Davies. April 12th.
10,445. "Submarine signalling apparatus." L. J. Price. April 12th.
10,462. "Thermionic valve holders." G. H. Moody. April 12th.
10,466. "Burglar alarm." S. C. Harvard. April 12th.
10,469. "Automatic telephone systems." H. T. Body, W. H. Grinsted, and Siemens Bros. & Co., Ltd. April 12th.
10,472. "Electric battery lamp." W. Sandford. April 12th.
10,474. "Electric time switches." F. Krupp Akt. Ges. April 12th. (Germany, May 23rd, 1921.)
10,480. "Transmission of telephone numbers, &c." Automatic Telephone Manufacturing Co., Ltd., and H. H. Harrison. April 12th.
10,486. "Advertising device." Edison Swan Electric Co., Ltd. April 12th.
10,498. "Electric switches." J. B. Tucker. April 12th.
10,499. "Electric switches." J. B. Tucker. April 12th.
10,507. "Telephone repeater circuits." General Electric Co., Ltd., and G. C. Marris. April 12th.
10,509. "Indicator systems for lifts, &c." F. G. Bell and Sterling Telephone & Electric Co., Ltd. April 12th.
10,512. "Electric furnaces." E. P. Barfield and L. W. Wild. April 12th.
10,513. "Rectifiers for electric currents." M. Morrison. April 12th. (United States, April 12th, 1921.)
10,516. "Electrical apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). April 12th.
10,517. "Automatic warning signals for railways, tramways, &c." C. W. Tozer and D. D. Walker. April 12th.
10,518. "Contact rail for electric traction." H. Parodi. April 12th.
10,520. "Electric discharge tubes." H. L. Down and W. A. Hole. April 12th.
10,525. "Single flash radiography." F. Hernaman Johnson. April 12th.
10,527. "Electric installations for lighting, &c., on motor cars, &c." C. A. Vandervell and C. A. Vandervell & Co., Ltd. April 12th.
10,538. "Devices for connecting electric, &c., wires." G. W. Humphry. April 12th.
10,539. "Electric wiring systems for lead-sheathed cables, &c." G. W. Humphry. April 12th.
10,548. "Closed electric furnace." A. Helfenstein. April 12th. (Austria, April 12th, 1921.)
10,572. "Electrically-operated warning horns." T. G. P. Healey. April 13th.
10,580. "Electric switches." J. Clément and L. Gillard. April 13th.
10,585. "Electric switches." J. A. Crabtree. April 13th.
10,586. "Electric switches." J. A. Crabtree. April 13th.
10,598. "Method of jointing electric conductors." J. F. Schleper. April 13th.
10,612. "Adjustable clips for electrical wiring." A. G. Bullen. April 13th.
10,627. "Sparking plugs." Soc. Anon. des Anciens Etablissements Panhard et Levassor. April 15th. (France, April 13th, 1921.)
10,628. "Permanent magnets." F. Krupp Akt. Ges. April 13th. (Germany, June 29th, 1921.)
10,629. "Electric overload protective systems." F. Krupp Akt. Ges. April 13th. (Germany, May 28th, 1921.)
10,649. "Cooling of electrical apparatus." Bureau d'Organisation Economique. April 13th. (Germany, April 13th, 1921.)
10,650. "Electrolysis of water." R. Pechranz. April 13th.
10,656. "Electric distributing systems." N. Togami. April 13th.
10,659. "Electric batteries." F. Lis. April 13th.
10,660. "Electric cooking devices." S. M. Townsend. April 13th.
10,666. "Electromagnetic regulating devices for dynamo-electric machines." J. Etchells and Vickers, Ltd. April 13th.
10,671. "Alternating-current distributing systems." Ferranti, Ltd., and A. H. Higgs. April 13th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1920.

29,625. "Electro-mechanical power transmission devices." H. Potter. August 20th, 1921. (177,557.)
33,192. "Portable electric light and power plant." C. H. Ferguson. November 24th, 1920. (177,569.)
33,703. "Process and installations for the electro-mechanical utilisation of tides." A. Defour. November 29th, 1920. (177,576.)
35,627. "Protective devices for electrical power transmission systems." E. M. Royce (G. H. B. Bernard). December 18th, 1920. (177,582.)
35,922. "Electrical instruments." M. B. Field. December 22nd, 1920. (Cognate application 27,937/21.) (177,584.)
36,407. "Electro-magnetic relays or like contact-making devices." Automatic Telephone Manufacturing Co., Ltd. September 7th, 1920. (Addition to 156,076.) (168,844.)
36,474. "Means for actuating electric switches." A. C. Day. December 30th, 1920. (Convention date not granted.) (157,079.)
36,503. "Apparatus for testing dynamo electrical machines." A. Ytterberg and Allmanna Svenska Elektriska Aktiebolaget. December 30th, 1920. (177,603.)
36,625. "Apparatus for coating metals with metal." British Thomson-Houston Co., Ltd. (General Electric Co.). December 31st, 1920. (177,608.)
36,626. "Current-collecting devices for dynamo-electric machines or the like." British Thomson-Houston Co., Ltd. (General Electric Co.). December 31st, 1920. (177,609.)
36,666. "Electricity multicore cable dividing boxes or apparatus." South Wales Electrical Power Distribution Co. and A. Wisdom. December 31st, 1920. (177,610.)

1921.

356. "Electrical condenser and method of making the same." W. Dubilier. January 18th, 1916. (156,483.)
652. "Means for regulating the terminal voltage of electrical valve-tubes." Dr. F. Schroter. September 1st, 1919. (156,664.)
983. "Testing arrangements for automatic telephone systems." Siemens and Halske Akt. Ges. March 26th, 1918. (157,117.)
1,236. "Arrangement for telephone installations with automatic exchange working." Siemens & Halske Akt. Ges. December 8th, 1916. (157,324.)
1,324. "Wireless telegraph receivers." Ges. fur Drahtlose Telegraphie. August 29th, 1919. (157,403.)
1,388. "Means for interrupting electric currents, particularly applicable to lightning arresters." Schweitzer & Conrad. June 21st, 1918. (157,457.)
1,398. "Means for the optico-electric reproduction of photographically recorded sounds." Dr. J. Engl, H. Vogt and J. Massolle. December 22nd, 1919. (157,466.)
1,740. "Type of swivelling shoe collector for the collecting of electric power from overhead conductor." F. H. Briggs. January 11th, 1921. (177,634.)
2,670. "Pendulum electrical indicators." R. Scruby. January 20th, 1921. (177,639.)
3,056. "Electric motor starters and regulators." A. H. Railing, C. C. Garrard, and W. Wilson. January 25th, 1921. (177,643.)
3,271. "Electric switches." A. Shore and A. P. Witchell. January 26th, 1921. (177,645.)
3,409. "Electric switches." A. H. Railing, C. C. Garrard, and A. F. Searle. January 28th, 1921. (Addition to 132,936.) (177,651.)
5,491. "Electric cables or conductors." J. Drennan. February 17th, 1921. (Cognate application 15,826/21.) (177,666.)
5,837. "Sparking plugs for ignition purposes." A. E. Heath. February 21st, 1921. (177,671.)
5,905. "Dirigible headlights for motor vehicles." J. J. Bavor. February 21st, 1921. (177,672.)
6,161. "Means for actuating repeater signals on locomotives or motor cabs of electric railways." J. Bethenod. February 24th, 1920. (159,471.)
6,619. "Electrically-heated soldering irons." W. Clark and Clark's Neo-Electric Devices, Ltd. February 28th, 1921. (177,678.)
7,035. "Manufacture of electric cables for conveying energy." L. N. Reddie (Soc. Pirelli & Co.). March 3rd, 1921. (177,683.)
8,775. "Electric starters for internal-combustion engines." Z. R. Della Veneria. March 23rd, 1920. (160,729.)
9,473. "Speed-regulating systems for electric motors." British Thomson-Houston Co., Ltd. (General Electric Co.). March 30th, 1921. (177,708.)
9,911. "Apparatus for suppressing the upper harmonic waves in the direct-current circuit of metal vapour rectifiers." Akt. Ges, Brown, Boveri et Cie. May 15th, 1920. (163,686.)
10,005. "Sparking plugs." L. S. Clarke. April 5th, 1921. (177,712.)
10,051. "Plug connections for electric circuits." G. F. Ostins. April 5th, 1921. (177,713.)
11,038. "Rotary timing switches or current distributors for ignition apparatus of internal-combustion engines." R. S. Bowen. April 17th, 1920. (161,917.)
12,352. "Sound receiving equipment for ships." Signal Ges. May 31st, 1920. (164,311.)
13,601 "Lapping strips of paper and the like on electric conductors and the like." C. J. Beaver and E. A. Claremont. May 13th, 1921. (177,731.)
13,762. "Electric liquid heating appliances." E. Richter. May 17th, 1921. (177,732.)
15,261. "Electric resistance units." W. R. Mickelwright and Mickelwright, Ltd. June 2nd, 1921. (177,735.)
16,881. "Electrical operation and control of railway carriage doors." National Pneumatic Co. September 10th, 1920. (168,858.)
20,777. "Electric installations comprising an electric generating set combined with a storage battery." J. Bethenod. November 8th, 1920. (171,385.)